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Summary Report of the Highway Strategy

October 1999

Northwest Territories

Transportation

Summary Report of the Highway Strategy

Department of Transportation
Government of the Northwest Territories

October 1999

Table of Contents

A. Introduction

B. Slave Geologic Province Transportation Corridor **(Blue Pages)**

- B.1 Consultations
- B.2 Studies Undertaken
- B.3 Executive Summary of the Need/Feasibility Study
- B.4 Executive Summary of the Environmental Scoping Study
- B.5 Executive Summary of the Mapping and Route Analysis Study
- B.6 Summary of the Cost Estimates Study

C. Inuvik Tuktoyaktuk Road **(Green Pages)**

- C.1 Consultations
- C.2 Studies Undertaken
- C.3 Executive Summary of the Environmental Scoping Study
- C.4 Summary of the Pre-Engineering Study
- C.5 Executive Summary of the Benefit Cost and Economic Impact Analysis
- C.6 Executive Summary of the Financing Study
- C.7 Executive Summary of the Land Issues Study

D. Mackenzie Valley Highway Extension **(Pink Pages)**

- D.1 Consultations
- D.2 Studies Undertaken
- D.3 Executive Summary of the Environmental Scoping Study
- D.4 Summary of the Engineering Update Study
- D.5 Executive Summary of the Benefit Cost and Economic Impact Analysis
- D.6 Executive Summary of the Financing Study

E. Highway 3 Accelerate Reconstruction Rae to Yellowknife **(Yellow Pages)**

- E.1 Introduction
- E.2 Report on the Pros and Cons of Accelerating Highway 3 Reconstruction

B. Slave Geologic Province Transportation Corridor

B.1 Consultations

An initial Stakeholder Workshop was held in Yellowknife on June 4, 1998, to discuss issues and opportunities surrounding this corridor. The workshop was attended by approximately 70 stakeholders.

Following the workshop a Stakeholder Advisory Committee was set up. This committee consisted of eleven individuals from industry, Aboriginal organizations and government. A list of the committee members is provided below.

- Henry Zoe, Treaty 11 Council;
- Charlie Lyall, Kitikmeot Corporation;
- Darrel Beaulieu, Yellowknife Dene;
- Bob Dowdall, North Slave Metis;
- Bob McKinnon, City of Yellowknife;
- Chris O'Brien, Ecology North;
- Marvin Robinson, NWT Construction Association;
- John Zigarlik, Nuna Logistics;
- Gerry Avery, NWT Chamber of Commerce;
- Ray Anderson, NWT Trucking Association; and
- Mike Vaydik, NWT Chamber of Mines.

This committee met on July 20, 1999, to discuss the studies proposed by the Department. A second meeting of the committee was held on March 16, 1999, in which the status of the initiative and the results-to-date were presented.

Formal consultations were also undertaken as part of the Need and Feasibility Study and the Environmental Scoping Study. For the Need/Feasibility Study consultations were conducted directly with key stakeholders, either in-person or by telephone.

For the environmental scooping study, the study consultants and Department representatives traveled to each of the affected communities for public meetings to discuss socio-economic and environmental issues. A schedule of the meetings is provided below.

- Yellowknife – January 27, 1999
- Rae/Edzo – January 28, 1999
- Bathurst Inlet – February 8, 1999
- Umingmaktok – February 8, 1999
- Cambridge Bay – February 10, 1999
- Kugluktuk – February 11, 1999
- Dettah – February 16-17, 1999
- Lutsel k'e – May 19, 1999

In addition, the Department has held a number of formal and informal discussions with various interest groups to discuss the studies.

B.2 Studies Undertaken

Summaries of the following four studies undertaken by the Department on the Slave Geologic Province Transportation Corridor are attached.

- Need/Feasibility Study
- Environmental Scoping Study
- Mapping and Route Analysis Study
- Cost Estimates Study

A fifth study on economic impact and benefit cost analysis of future developments will be undertaken later this year, after updating of the Northwest Territories Input/Output model is complete.

B.3 Executive Summary of the Need/Feasibility Study Slave Geologic Province Transportation Corridor

ARTHUR ANDERSEN

SLAVE GEOLOGIC PROVINCE TRANSPORTATION CORRIDOR NEED/FEASIBILITY STUDY

FINAL REPORT

Government of the Northwest Territories

Arthur Andersen LLP
Simons International Corporation
Aboriginal Engineering Limited
Enfotec
McCormick Rankin Corporation

March 29, 1999

EXECUTIVE SUMMARY

A strategic objective of the Department of Transportation of the Government of the Northwest Territories (GNWT) is to create new transportation infrastructure to promote economic development. To meet that objective, the Department of Transportation is undertaking a number of transportation planning initiatives and studies including need and feasibility assessments, and engineering, environmental, benefit-cost analyses and financing studies. One of the transportation initiatives being studied is the Slave Geologic Province (SGP) Transportation Corridor.

Arthur Andersen in association with Simons International, Aboriginal Engineering Limited, Enfotec, and McCormick Rankin Corporation* were contracted in September, 1998 to undertake the Slave Geologic Province Transportation Corridor Need/Feasibility Study. The Slave Geologic Province (SGP) covers approximately 190,000 square kilometres of land in the region of the Northwest Territories extending north from Yellowknife to the Arctic Coast in a band approximately 300 kilometres wide. The SGP is generally rich in mineral deposits and is recognized as having significant potential for gold, base metals and diamond production. Mineral development in the SGP, however, has been somewhat constrained by the existing transportation system. Specifically, while the southern portions of the Province are accessible by all-weather roads, parts of the northern portion are only accessible by privately developed winter roads, and no road access is available in many other parts of the SGP.

The overall purpose of this study is to examine the need and the feasibility of a transportation corridor into or through the SGP, and to propose appropriate structures for implementing the project. Specifically, the objective of this study is to take a 'high-level' look at the need and feasibility of improved transportation infrastructure in the SGP, and provide recommendations for advancing the project. The study involves an assessment of project need, routing, level of service, construction phasing, major constraints to development, financial viability and financial arrangements. This study will provide strategic direction for future transportation investments in the SGP for the

* Peer review capacity.

Government of Northwest Territories and, as of April, 1999, for the newly created Government of Nunavut, whose mandate will include transportation planning responsibilities for the northern portion of the SGP.

Key analyses of the study are outlined below.

Mining Potential of the Slave Geologic Province is Enormous

The Northwest Territories was ranked as having the greatest mineral potential of all of the provinces and territories in Canada based on a survey of mining companies undertaken by the Fraser Institute in 1997. The SGP is the richest and most promising mining region within the Northwest Territories.

Over the past couple of years the exploration expenditures in the Northwest Territories represented over 20 percent of the total dollars spent on mineral exploration in Canada. This is because of both the increased level of activity and the higher cost of exploration as a result of limited seasonal access.

The importance of recent discoveries as a factor in the funding of future explorations is best illustrated by the increase in exploration activity in Newfoundland and the Northwest Territories following the discoveries of Voisey's Bay and Ekati. Exploration expenditures in the Northwest Territories increased from $43 million to $101 million between 1992 and 1993. In Newfoundland, expenditures increased from $12 million in 1994 to $71 million in 1995.

To place the mineral potential of the SGP in the long term context, the SGP can be compared to the Abitibi Geologic Province in northern Ontario and Quebec, where more than 100 mines have been developed over the last 100 years. Thus, much of the SGP and surrounding areas are yet to be explored.

Currently there are over 30 mining "projects" in the SGP at various stages of development (see the attached table and map). The table itemizes the existing projects, commodity of interest and the stage of development. The map shows the location of the existing mines and projects.

SLAVE GEOLOGIC PROVINCE TRANSPORTATION CORRIDOR
NEED/FEASIBILITY STUDY
FINAL REPORT

EXECUTIVE SUMMARY

Cooperation between the Western GNWT, Nunavut Government is Essential

The Slave Geologic Province transportation corridor is a single "transportation system" located in two territories. The portions in one territory cannot be developed in isolation of the other. Therefore, it is essential that formal coordinating mechanisms be established between the responsible departments in the two territorial governments.

Continued Liaison with the Aboriginal Groups, Federal Government and the Mining Industry is Required

Additional Studies and Analyses are Required

These include, among others:

- Economic Impact, Taxation Revenue and Benefit-Cost Analysis;
- Winter Road Capacity Analysis;
- Discussion and Analysis of Policy and Operational Aspects of the Winter Road from a Western GNWT Viewpoint;
- A Detailed Tourism Opportunity and Impact Study ;
- An Investment-Calibre Financial Analysis (to be conducted after further discussions with the federal government, Nunavut government, Aboriginal Groups, Mining Industry, etc.).

A. Introduction

This summary report presents a concise summary of the results for each of the studies undertaken as part of the Highway Strategy initiative.

The Department of Transportation received $2 million in May of 1998 to undertake background planning work on four road projects, as part of the Highway Strategy initiative. The four projects included in this initiative are:

- Slave Geological Province Transportation Corridor;
- Mackenzie Valley Highway Extension;
- Inuvik-Tuktoyaktuk Road; and
- Acceleration of Highway 3 Reconstruction, Rae to Yellowknife.

These roads are also illustrated in the figure attached.

The funding allocated to this initiative was used to undertake economic, environmental, financing and pre-engineering studies for each of the four road projects.

Extensive consultations with all stakeholders have been undertaken under this initiative. These include stakeholder workshop, setting up Stakeholder Advisory Committees to provide advice and direction to studies, along with public consultations and one-on-one interviews with key stakeholders. The Department has presented the preliminary study results to the Stakeholder Advisory Committees. This initiative has been successful in both establishing a comprehensive database of information on new road construction in the Northwest Territories, and by involving all stakeholders in this process.

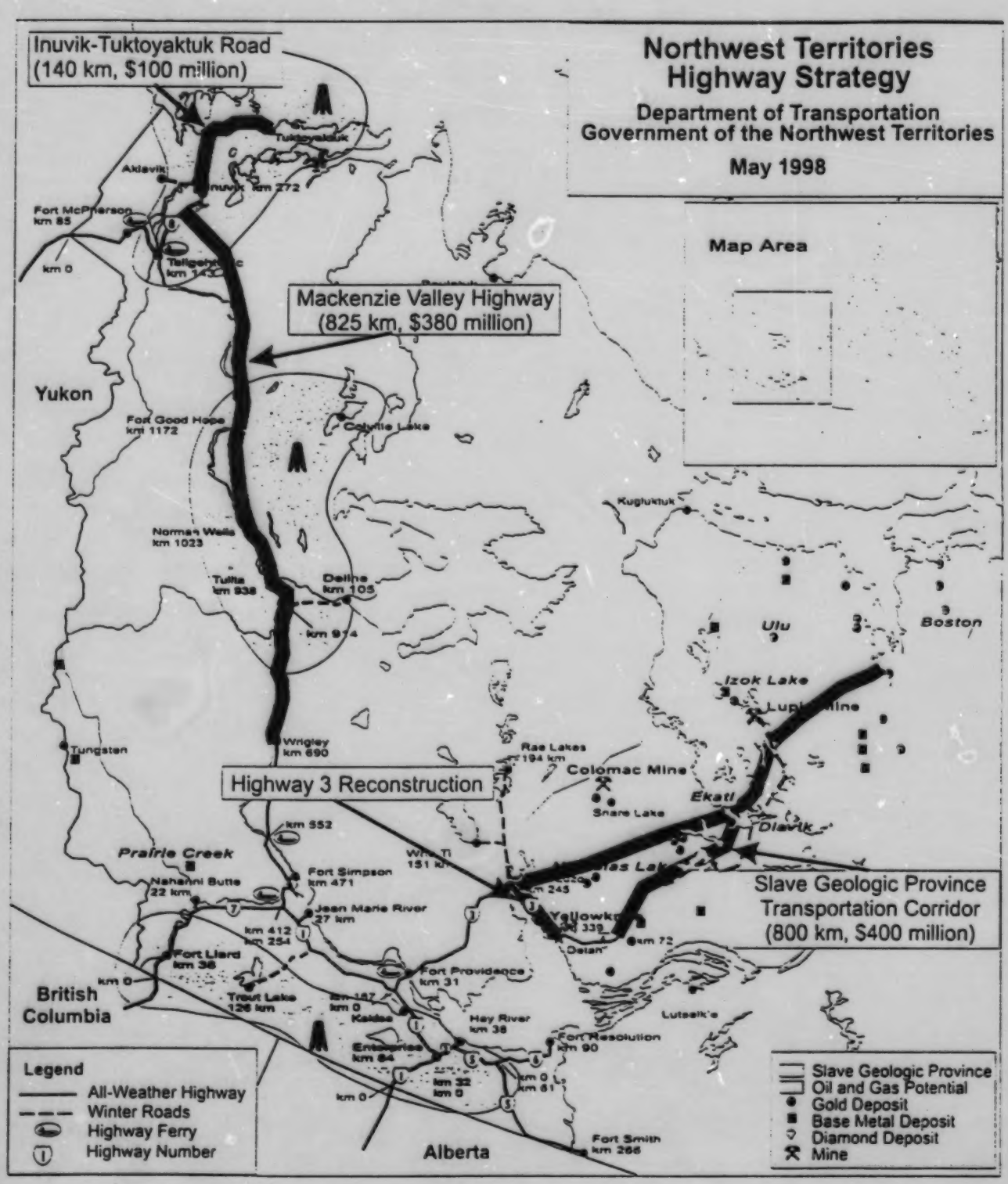
The purpose of this report is to summarize the results of the studies undertaken, and in so doing present a concise and comprehensive summary of the knowledge gained as part of the Highway Strategy initiative.

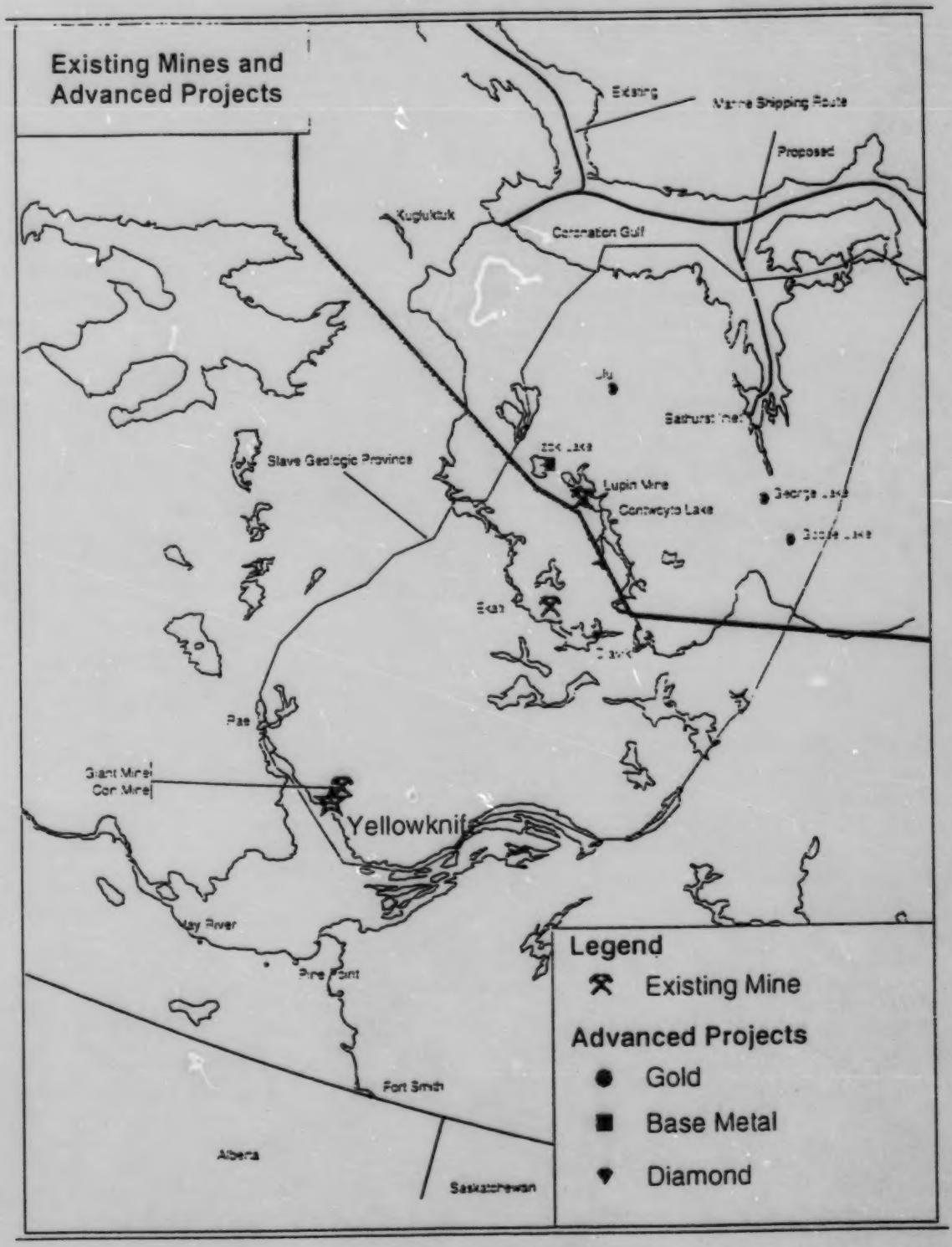
The four sections that follow present the results of the studies for each road project. Details of the consultations undertaken for each road are provided first, followed by a summary of each study undertaken.

It is noted that the Department of Transportation is preparing a second report which will outline the Department's vision for new roads and a plan-of-action to achieve the vision.

The results presented in this report will make an important contribution to the government's Economic Strategy which is currently being developed by the Economic Strategy Panel.

For additional information on the results presented in this report, contact the Transportation Planning Division at (867)873-7666.


Inuvik-Tuktoyaktuk Road
(140 km, $100 million)
Northwest Territories
Highway Strategy
Department of Transportation
Government of the Northwest Territories
May 1998
Map Area
Mackenzie Valley Highway
(825 km, $380 million)
Yukon
Highway 3 Reconstruction
Slave Geologic Province
Transportation Corridor
(800 km, $400 million)
British
Columbia
Alberta
Tuktoyaktuk
Aklavik
Inuvik km 272
Fort McPherson
km 85
km 0
Fort Good Hope
km 1172
Colville Lake
Norman Wells
km 1023
Tulita
km 938
Deline
km 105
km 914
Wrigley
km 690
Tungsten
Kugluktuk
Ulu
Boston
Izok Lake
Rae Lakes
194 km
Colomac Mine
Snare Lake
Ekati
Diavik
Prairie Creek
km 552
Fort Simpson
km 471
Nahanni Butte
22 km
Jean Marie River
27 km
km 412
km 254
Fort Liard
km 36
km 0
Trout Lake
126 km
km 147
km 0
Kakisa
Fort Providence
km 31
Hay River
km 38
Enterprise
km 64
km 32
km 0
km 0
km 0
km 61
Fort Resolution
km 90
Lutselk'e
Fort Smith
km 266
Legend
All-Weather Highway
Winter Roads
Highway Ferry
Highway Number
Slave Geologic Province
Oil and Gas Potential
Gold Deposit
Base Metal Deposit
Diamond Deposit
Mine


Existing Mines and Advanced Projects
Existing
Marine Shipping Route
Proposed
Kugluktuk
Coronation Gulf
Bathurst Inlet
Slave Geologic Province
Lupin Mine
Contwoyto Lake
George Lake
Diavik
Ekati
Pas
Giant Mine
Con Mine
Yellowknife
Pine Point
Fort Smith
Alberta
Saskatchewan
Legend
Existing Mine
Advanced Projects
Gold
Base Metal
Diamond

The foregoing show that a large number of the projects are still in the exploration stages, and of these, only about five are currently considered active. The reasons that the others are inactive include lack of exploration funds due to poor economic conditions, the resource/reserve estimates are currently economically unviable without either additional drilling or improved infrastructure, or current owners are restructuring and properties are in the process of being vended. The improvement of transportation infrastructure in the north will reduce the costs of exploration and increase the probability of some of these properties being put into production. However, it should be noted that a property in the exploration phase can be five to ten years away from production.

Mineral Projects in the SGP

Project/ Mining Operations	Commodity	Status
Lupin	Gold	Operations currently suspended due to decline in gold prices. Estimated mine life of 6 - 8 yrs.
Ekati	Diamonds	Began production in October 1998.
Advanced Projects - feasibility Study underway or completed		
Diavik	Diamonds	Feasibility study near completion.
Ulu	Gold	Feasibility study complete, awaiting improvement in gold prices.
Izok Lake	Base metals	Feasibility study complete, current owners looking to sell property. Feasibility study indicates that the project economics cannot withstand the additional infrastructure costs.
George Lake	Gold	Feasibility study started but put on hold due to decline in gold price. Will benefit from improved infrastructure.
Thor Lake	Rare Earth	Application has been made for a Water Licence.
Advanced Exploration Projects - Pre-feasibility study stage		
Boston	Gold	Awaiting improvement in economics before going to feasibility study. This project is on the eastern shores of Bathurst Inlet and will only benefit from the port infrastructure.
Damoti Lake	Gold	May move to pre-feasibility or feasibility. Awaiting for improvements in gold price.
Gondor	Base Metal	Associated with Izok Lake deposit. Would be mined after Izok Lake deposits.
Jericho	Diamonds	Drilling program underway and initial studies completed.
Nicholas Lake	Gold	Property could go to feasibility study, if gold prices improve.
Exploration Projects		
Boot Lake	Gold	Status of property unknown.
Back Lake	Diamonds	Exploration programs underway, work on the property is progressing
Coronation Gulf	Gold	Diamond drilling complete and preliminary ore resource calculation completed.

Camsell Lake	Diamonds	Exploration programs underway, work on the property is progressing. The collection of a bulk sample is planned in 1999.
Epworth	Base Metal	Exploration programs underway, work on the property is progressing.
High Lake	Base Metal	Diamond drilling complete and calculation of ore resources done.
Hood River	Base Metal	Could possibly be exploited if Izok put into production.
Kennady Lake	Diamonds	Work on this property is progressing. The collection of a bulk sample is planned in 1999.
Kim/Cass	Gold	Status of property unknown.
Mackay Lake	Diamonds	Exploration program underway, work on the property is progressing.
Mazenod Lake	Base Metal	A scoping study was completed in 1998. This project is also near existing transportation infrastructure.
Musk	Base Metal	Requires additional exploration work before moving project forward.
Pistol Lake	Gold	Western shores of Bathurst Inlet would only benefit from port infrastructure.
Russell Lake	Gold	Near the highway between Rae and Yellowknife.
Sunrise	Base Metal	Diamond drilling complete and preliminary resource estimates calculated.
Tundra (Fat)	Gold	Exploration program currently underway.
Turner Lake	Gold	Some diamond drilling completed.
Wreck Lake	Copper	Early exploration stage.
Yava	Base Metal	Early exploration stage.

Source: Simons International 1998

Availability and Cost of Transportation is an Impediment to Mining Developments

The accessibility of transportation infrastructure is an important aspect in all phases of a mining project, from initial grassroots exploration through to operations. Accessibility to good transportation infrastructure can result in easier project planning, reductions in capital and operating costs, and reduction in project risks. Without good transportation access, generally only the richest gold and diamond ore bodies will be developed and the development of any base metal operations is unlikely.

Transport costs are part of the cost of all mining developments from the initial exploration through construction to ongoing operations. The relative importance of transport costs to the overall mine economics varies with the location of the mine and the size and type of mineral(s) being mined. Transportation costs are estimated at 1 percent to 2 percent of the cost of construction for all mines. During the mine operation phase, transportation costs make up a much higher proportion of the

costs: 10 percent to 15 percent for a diamond or gold mine, and 20 percent to 25 percent for a base metal mine.

The following general points can be made about the impact of availability and cost of transportation infrastructure on mining development in the Northwest Territories.

- The capital costs associated with the transportation typically include the costs for an airstrip and in some cases, particularly base metal mines, the costs for roads and ports and the cost of additional storage facilities associated with winter road access.

- Limited (seasonal) access translates into increased working capital requirements for supply inventories, and in the case of base metal mines, product inventories.

- Most mines do not require an all-weather road during the construction phase. An all-weather road would reduce construction schedule risks, but have only a marginal impact on the project's capital cost.

- During the operations phase of diamond, gold and base metal mines, the vast majority of inbound cargo consists of fuel for power generation. The products of gold and diamond mines are transported by air. However, the ore concentrates produced by base metal mines must be transported to smelters, largely based in Canada, and accessed primarily by ocean going ships.

- For diamond mines, an all-weather road is not required. The high quality of the ore reserves and the limited supply requirements mean that winter roads can be used, as long as the winter road(s) can handle the increased traffic volumes. This is also true for a majority of gold mine projects.

- The base metal mines ship out large quantities of ore concentrate, and must therefore have access to a port and preferably an all-weather road. It should be noted that most of the base metal mines developed in the Northwest Territories to date, including Polaris and Nanisivik, are on tidewater.

Whether lower transport (truck and air freight) costs incurred in the SGP will turn a given mineral deposit in the SGP into a viable mine cannot be determined without assessing the specifics of each case. Although transport costs are known to be high in remote regions, the costs may be offset by higher grade ores or other factors that make the overall mine costs competitive. What can be generalized is that lower transport costs will always enhance the economics of a mine. In some cases, assuming other factors being equal, then the availability of cheaper transportation infrastructure elsewhere in Canada or abroad may be the deciding factor in where the mining companies may invest.

Forecast of Mineral Development Scenarios and their Transportation Needs

Four phases of mining development in the SGP were forecast over the next 20 years, based on consultation with the mining companies operating in the SGP, and a review of current mining activity, and the current status of the projects. It should be noted that a mineral property in the exploration phase can be five to ten years away from production, assuming everything falls into place as expected.

The transport needs for each assumed phase of development is as follows:

Phase #1 (year 1999) represents the current scenario, with two mines, Ekati and Lupin, in operation (for this analysis it has been assumed that the Lupin mine is operational). There are no compelling additional transport needs for this phase. No all-weather road is required. Improvements to the Lupin winter road would be welcomed by the existing mine owners provided they would lower annual costs.

Phase #2 (years 2000 - 2010) assumes that Ekati and Lupin, as well as a second diamond mine (Diavik) and one base metal mine (Izok Lake) are operating. All-weather transportation infrastructure would have to developed in order for the base metal mine to be put into production. An Arctic port accessed by an all-weather road from a point near the new base metal mine and new ice-breaking bulk carriers are prerequisite transport needs to service the base metal mine. The existing Lupin winter road has the capacity to handle the construction and operation of

Diavik's new diamond mine. Some improvements to the capacity and/or operations of the winter road would be helpful.

The existence of the northern port and all-weather road is likely to mean that the majority, but not all, of the fuel currently brought from Edmonton via the winter road, could start being transported via the northern port and all-weather road because of cost savings. Most of the supplies for all mines, including Izok Lake, will continue to be transported from southern Canada via the winter road.

Phase #3 (2005 to 2015) assumes that a third diamond mine and an additional gold mine (possibly George Lake) are in operation.

A new winter road from the south to the new mines and/or improvements to the existing winter road will be required to service the increased traffic.

No detailed analysis has been undertaken in this study relative to the winter road capacity but it is a critical issue which needs to be followed up. A separate study which examines the existing design and operating rules and reviews the options available for increasing the capacity of the winter road should be carried out. Possible options include: improving the portages, extending the all-weather road north by 30 km, twinning the lake sections, and changing the operating rules.

The location and magnitude of additional winter road capacity can only be determined when the number, location, timing, and size of the new mines is known.

Phase #4 (years 2010 - 2020) assumes that an additional base metal mine (in the Nunavut part of SGP) is in production and one of the diamond projects proceeds to the underground phase of development. Thus seven mines will be operating in the SGP.

The forecast tonnages indicate that if seven mines are operating in the SGP (in Phase 4) the inbound tonnages, although still relatively small, would almost certainly require more winter road capacity than exists at present. Each mine will need to have at least winter road access from the south for both the construction and operation phases when most commodities other than fuel and some of the fuel would still be sourced

from southern Canada. The outbound tonnages by road in Phase 4 are made up solely of concentrates from two base metal mines and must rely on the northern all-weather road and port.

At this level of activity it would be beneficial to upgrade the southern winter road connection to an all-weather standard. It should be noted that the relatively small amount of traffic generated by the diamond and gold mines will not be sufficient to finance the southern all-weather road through tolls alone.

Tourism

Key findings related to tourism are as follows:

- Improved access, particularly to the scenic areas such as along the East Arm of the Great Slave Lake and other lakes in the SGP, could benefit tourism by providing opportunities for further development of trails, parks and eco-tourism opportunities. Some types of tourism, such as recreational vehicle based tourism, may benefit from improved access, while other types, such as those that are dependent on remoteness, may be adversely affected.

- Ultimately, the level of economic benefit from increased tourism associated with a new transportation corridor will depend on whether the development will result in additional people visiting the region or visitors extending their length of stay - either of which would have a positive effect, as more money would be spent in the Region.

- Further analysis of impacts on the tourism industry and the extent and distribution of benefits should be undertaken as part of a detailed benefit-cost analysis study. An assessment should be undertaken of whether the availability of a transportation corridor would encourage visitors to extend their length of stay and visit parts of Nunavut (or the NWT) via the SGP transportation corridor. Consideration should also be given to the need and demand for additional tourism infrastructure along specific areas of the SGP, and near the port at Bathurst Inlet. Finally, consideration should be given to the impact and opportunities for tourism that would be associated with the presence of a port facility at Bathurst Inlet.

Financing Feasibility of an All-Weather Road

Key findings of the Financial analysis are noted below:

- A mine located near Contwoyto Lake is assumed to pay tolls on 320,000 tonne/year ore concentrate at an estimated unit price of $0.125 per tonne-km, and at $0.10 per km of fuel for the use of an all-weather road to a port on Bathurst Inlet. On that basis, the all-weather road from Contwoyto Lake to a port at Bathurst Inlet (similar to that proposed by Nuna Logistics) could be mostly self-financing.

  At an assumed private sector borrowing rate of 12.5 percent, the toll revenues would cover 93 percent of capital costs at $300,000/km road construction cost, and 56 percent of capital costs at $600,000/km road construction cost.

  At the government borrowing rate of 5.5 percent, the corresponding figures would be 179 percent and 108 percent, respectively.

- Because the traffic volumes generated by diamond and gold mines are much smaller, the corresponding figures for an all-weather road for the southern section of the corridor from Rae/Yellowknife would between 2 percent and 8 percent.

- If an all-weather northern road and port are built, an estimated 80 percent of the fuel import by the SGP mines could come from the north; and the remaining 20 percent from the south via the winter road. The reason as explained below is a substantial saving in cost. Most of the other mine supplies are assumed to continue to be shipped from southern Canada via the winter road.

  The following table compares the overall costs to the Ekati mine under the existing winter road system to the costs under a new port and all-weather road system.

	Existing System Fuel Cost at Ekati (¢ per liter)	New System Fuel Cost at Ekati (¢ per liter)
Purchase Cost in Edmonton/Off-shore	22¢	20¢-22¢
Ocean Freight to Port	-	7¢
Rail Costs to Hay River	3¢	-
Trucking Costs Hay River to Yellowknife	5¢	-
Trucking Costs Yellowknife to Ekati /Port to Ekati	7¢	4¢
Toll/User Fee for Winter Road	4¢	0¢
NWT Petroleum Taxes	0 - 10¢	0 - 10¢
Total Purchase Cost	41¢ - 51¢	31¢ - 43¢

The cost savings could be as much as 10¢ per liter which equals $119 per tonne. A single mine using 40,000 tonnes of fuel per year could save up to $4.8 million per year in transport costs alone using the new system. In Phase 4, the total savings of all the mines could be as much as $24 million per year. In addition, a single mine such as Ekati could save up to $20 million in working capital if fuel could be brought in year round. A large portion of these savings could be used to pay for the operating costs of the new transport system in the form of a toll or user fee which in the above table were assumed to be 0¢.

Further savings for the base metal mines could be realized if the concentrate trucks could be designed to carry fuel back from the port on the return journey to the mine. These savings would accrue to the mine developers and stimulate more investment.

- It is noted that the construction of an all-weather road in the north and port at Bathurst Inlet will be to the Western NWT's eventual benefit. It will lower costs and spur additional development both east and west of the border, which may eventually lead to the upgrading of the southern winter road to an all-weather road. In addition, the flow of supplies from southern Canada to mines on both sides of the border will occur through the Western NWT, and benefit the economy.

Route Location (Rae vs Yellowknife)

There has been much local discussion related to the issue of whether an all-weather road from the south to the north should start at Rae or at Yellowknife. In addressing this issue, which cannot be resolved at this point, there are many factors which should be considered:

- The Rae versus Yellowknife question does not need to be answered yet. There is no compelling short-term reason for this road from a transport needs perspective. Long-term needs will depend on the amount of mining development in the SGP and whether a base metal mine/port/road development proceeds in Nunavut.

- The routing of the all-weather road would have to be agreed jointly by the financing parties. Until these parties are known, the route, which will also depend on the mines to be accessed, cannot be finalized.

- The costs of the road could vary considerably depending on its start point.

- A number of socio-economic, environmental and cost factors will need to be considered in determining the optimal route for the transport corridor.

Transport System Vision

It is recommended that the governments of both Nunavut and the Western NWT have a clear vision of the overall SGP transport system that will best suit both their needs. Such a vision can be used to solicit both public and private support for the difficult financing and approval processes which lie ahead.

Assuming that a base metal mine, Arctic port, and all-weather road goes ahead in Nunavut, what should the transport vision be for the Western NWT? Given that there is no pressing need for new transport facilities and no immediate prospect of a base metal mine requiring additional transport facilities in the Western NWT, the vision must be a long-term one that takes advantage of the opportunities created by the Nunavut system. In particular, there could be significant savings to Western NWT

mines if fuel was imported through the port. However, those savings could be realized only by the mines with winter road connections to Nunavut. An all-weather road connecting the Rae/Yellowknife area with the Nunavut all-weather road (into which the mines could connect) would lower both fuel transport and fuel inventory costs for the mines. Also, an all-weather road would allow year-round tourist and local traffic and could eliminate the short winter trucking season for new mines under construction throughout the SGP.

Although the benefits described can only be estimated until the number, location, timing, and type of new mines are better known, it is recommended that the long term transport vision for the Western NWT be an all-weather road that connects into the Nunavut all-weather road from the Rae/Yellowknife area.

Nunavut Transport System

The transport system proposed for Nunavut is a deep-sea port on Bathurst Inlet connected by an all-weather road to a point on the south end of Contwoyto Lake. This system, shown on Exhibit 4.6, would be required from the year 2000 to 2010 to meet the transport needs of Phase 2.

The transport system could be put in place immediately if the Nunavut government wished to take on the risk associated with constructing the transport infrastructure without a specific mine development to support it. Given the extremely high costs, a more acceptable alternative would be to find a base metal mine and port developer and shipper with a willingness to partner with the Nunavut government in financing the transport system and to proceed jointly with the mine and transport system development.

The expected level and type of traffic and the cost considerations of the public/private partners would dictate the design of the port road. The financing partners would determine the specific routing of the road.

Western NWT Transport System

The transport system proposed for the Western NWT is improvements to the existing winter road as dictated by the findings of a detailed winter

road capacity study as previously suggested and an all-weather road from the Rae/Yellowknife area to join the Nunavut all-weather port road. The all-weather road should only start when the Nunavut road is in place and be completed to meet the needs of Phase 4 expected in the year 2010 to 2015.

Summary and Follow-Up Studies Required

The following points are provided to summarize the follow-up activities required.

<u>The SGP Transportation Corridor should be marketed as Investment in Long Term Well-being of Canada and the North</u>

Some 31 mining projects are at various stages of development in the Slave Geologic Province, including one project which is currently operational, one on stand-by, five projects which have feasibility studies either underway or completed, five additional projects which are at the pre-feasibility stage, and 19 projects which are at the exploration stage.

Clearly, the development of the SGP Transportation Corridor will improve the operating economics of a number of these projects, through a combination of reduced transportation costs and reduced fuel costs, and the combination of these potential savings may cause a number of projects to proceed to more advanced stages.

As a result, the proposed roadway should not be viewed in isolation of the broader direct benefits which it is able to generate, including the increased tax revenues which would therefore accrue to the Federal Government from increased mineral exploration and mining activity, and which presumably could then be redirected from Ottawa to the NWT and Nunavut as their contribution to this roadway. As stated previously, the magnitude of such impacts should be reviewed as part of any subsequent research initiated to more precisely quantify the expected financial performance of the roadway.

B.4 Executive Summary of the Environmental Scoping Study Slave Geologic Province Transportation Corridor

1 EXECUTIVE SUMMARY

1.1 Background

The Department of Transportation (DOT) of the Government of the Northwest Territories (GNWT) is preparing a highway strategy to plan for the development of a transportation corridor through the Slave Geological Province (SGP) for the purpose of mineral development and transshipment. Significant mineral resources have been identified in the SGP; however, little development has occurred. Improved infrastructure would enhance the economics of these deposits by lowering access and production costs in the SGP (DOT 1998). The corridor under consideration encompasses the North Slave communities of Rae-Edzo and Yellowknife, the existing Lupin Winter Road alignment, current and proposed mining development properties, and the location of known and favourable mineral resources in the SGP (Fig 1.1).

Existing transportation infrastructure in the SGP is limited. NWT Highways # 3 and # 4 provide all – weather road access to the communities of Yellowknife, Rae-Edzo, and Dettah. A public winter road is built annually from Rae-Edzo to the communities of Wha Ti and Rae Lakes. Until recently, Royal Oak Mines annually constructed a winter road north of Rae-Edzo to their Colomac Gold Mine. The GNWT took advantage of this winter road to resupply Wekweti with fuel and construction materials by transporting materials from the winter road to the community by cat train. With the suspension of operations at Colomac in 1997, the winter road to this site is no longer constructed. The Lupin Winter Road, built and operated by Echo Bay Mines, is built annually from the terminus of Highway # 4 at Tibbit Lake to the Lupin Mine on Contwoyto Lake, has come to serve as an essential re-supply route for the operating mines and numerous exploration sites within the SGP. Each of the private operators in the SGP is required to construct their own access to the Lupin Winter Road. The winter road is approximately 500 kilometres long and provides access for a maximum of three months each year.

The idea of improving the transportation infrastructure in the SGP has been pursued, albeit intermittently, since the 1950s, when a report by Commissioner R. G. Robertson suggested building an extensive road network in the SGP to enhance development of mineral reserves. In the late 1970s, the Department of Indian Affairs and Northern Development (DIAND) undertook an analysis of future transportation infrastructure in the region, with a focus on encouraging mining development. In the early 1990s, Metall Mining examined potential transportation alternatives for accessing their base metal property at Izok Lake in the northern part of the SGP. A common theme in these studies was the inadequacy of the existing transportation system in supporting the development of base metal and other mineral deposits in the SGP, and the consequent need for an all-weather road.

ENVIRONMENTAL SCOPING, EXISTING DATA COLLECTION AND REGULATORY REQUIREMENT IDENTIFICATION FOR A TRANSPORTATION CORRIDOR IN THE SLAVE GEOLOGICAL PROVINCE NORTHWEST AND NUNAVUT TERRITORIES

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FSC PROJECT NO. 98-1570

APRIL 1999

Figure 1.1:
SLAVE GEOLOGICAL PROVINCE - POTENTIAL TRANSPORTATION CORRIDORS

To provide a long- term plan for the development of transportation in the Northwest Territories, DOT developed the Northwest Territories Transportation Strategy (DOT 1990). The strategy was updated in 1994. One of the strategic objectives of the Transportation Strategy, titled "Building New Transportation Corridors for Economic Development," involves the development of new roads and ports to provide low cost, reliable access that will encourage and sustain resource and other economic developments. Several new road initiatives were identified in the 1990 strategy; however, the Strategy Update (DOT 1995) and the New Roads Initiative (DOT 1998) refines the focus to: a road from Yellowknife to a port on the Arctic Coast, the extension of the Mackenzie Valley Highway from Wrigley to Inuvik and the construction of an all-weather between Inuvik and Tuktoyaktuk.

1.2 The Proposed Slave Geological Province Transportation Corridor

In March 1998, the GNWT announced its new roads initiative and dedicated funds for the socio-economic, environmental, and pre-engineering investigation of four new roads in the NWT, including the Slave Geological Province Transportation Corridor (SGP TC). At this early stage, the project remains conceptual with potential routing, design, and construction practices to be determined as part of the initial planning and scoping process.

Construction of a transportation route in the corridor would provide all-weather access to the SGP from the existing all-weather territorial highway transportation system in the south and the Arctic Coast in the north. As part of the proposed transportation corridor project, a port capable of handling ocean-going ships would be built at tidewater: Bathurst Inlet is the proposed site. Several corridor routes have been advanced, primarily by developers focusing on the logistics of providing access to their respective properties. A specific route has not been identified; however, several groups are reviewing potential routes and port locations in terms of cost, practicality, logistics, and potential financial contributors. If constructed from the end of the territorial highway system in the south to an Arctic Coast port, the transportation corridor could be approximately 850 kilometres in length. Figure 1.1 illustrates the general routing of transportation corridors presently being investigated.

The corridor would be expected initially, to consist of an all-weather road; however, future linear developments, such as communication or power transmission facilities, could also be located within the corridor. As it would be constructed primarily to serve industrial needs, the road would be built to industrial standard, incorporating design considerations related to terrain conditions and operational requirements. Preliminary costs to construct the road are estimated at $550 million, whereas port construction costs are estimated at approximately $50 million (DOT 1995). While the GNWT supports the development of a transportation corridor in the SGP, it has not made any commitment to develop the project.

1.3 Environmental Scoping of the Transportation Corridor

Ferguson Simek Clark, in association with Jacques Whitford Environment Limited, Lutra Associates Limited, and Aimm North Heritage Consulting, were retained by the DOT to conduct an environmental scoping study of the proposed SGP TC. In addition to the environmental scoping study, the DOT is also undertaking the following studies:

- Need/Feasibility analysis;
- Multi level Mapping, Route Analysis and Preliminary Cost Estimates; and
- Economic Impact, Benefit Cost and Taxation Revenue Analysis.

This Environmental Scoping Study was undertaken for the DOT in advance of any commitment by the GNWT or any other proponent to proceed with the SGP TC. This scoping study, in combination with the other studies identified above, is intended to assist the DOT in developing a strategy for transportation infrastructure in the SGP. Additionally, the scoping study will assist future proponents and regulators in preparing for the environmental assessment of the potential project.

Central to the scoping project was the identification of biophysical, social, economic, and cultural issues and concerns of project stakeholders regarding the potential development of the SGP TC. Issue identification necessitated the dissemination of project information to project stakeholders through a variety of fora. Issues identified would serve to focus a future environmental assessment, should the project proceed to development. Determination of the type of environmental assessment to which the potential SGP TC may be subject was also an objective of the study.

1.4 Stakeholders' Concerns

Project stakeholders include residents and users of the SGP and its resources, industry, government, regulators, Aboriginal organizations, and non-government organizations. Existing documentation was reviewed and consultations with stakeholders were undertaken to identify Valued Ecosystem Components (VECs), Valued Social Components (VSCs), and issues and concerns related to the potential effects of the SGP TC on the VECs and VSCs. The VECs, VSCs, and issues are documented in the report and are summarized below:

- Need for and purpose of project;
- Need for increased public consultation and discussion about the project;
- Desire by Aboriginal organizations for involvement and control in project;
- Cumulative environmental and social effects of the project:
- Effects of the project on the Bathurst Caribou Herd;
- Effects of providing all-weather access to SGP;
- Effects of access on harvesting and the sustainability of resources;
- Effects of the project on fish and wildlife and habitat, especially eskers;
- Effects of climate change on the project and the project on climate change;
- Effects on marine environment and resources, caribou and people of shipping in the Arctic and, Bathurst Inlet specifically;
- Effects of project on existing tourism operations in the SGP;

- Need for training, jobs, and business opportunities; and
- Potential social costs of the project, including drug and alcohol abuse, health and well being, and family stability.

The VECs, VSCs, and associated issues identified are intended to provide a focus for an environmental assessment of the SGP TC should it proceed.

1.5 Regulatory and Environmental Review Requirements

An important consideration in the planning for the development of a transportation corridor includes an examination of the regulatory and environmental assessment requirements that must be satisfied to achieve project approval. There has been considerable change and evolution of the regulatory framework for environmental assessment, land use planning, and resource management in Canada's North in recent years, due to:

- New and revised federal legislation (*e.g.*, the *Canadian Environmental Assessment Act* (*CEAA*) and regulations, the *Mackenzie Valley Resource Management Act* (*MVRMA*) and regulations);
- The creation of Nunavut; and
- The finalization of Aboriginal land claims agreements (*e.g.*, Nunavut Land Claims Agreement (NLCA), Inuvialuit Final Agreement, Gwich'in Comprehensive Land Claim Agreement, Sahtu Dene and Metis Comprehensive Land Claim Agreement).

The permits, licences, and authorizations potentially required for development and operation of the SGP TC have been identified. As presently conceived, the proposed SGP TC transects both Nunavut and the Northwest Territories, and would be subject to environmental assessment processes established in each jurisdiction. Additionally, the *Canadian Environmental Assessment Act* (*CEAA*) may also apply, depending on the project scope. The Nunavut, Mackenzie Valley, and *CEAA* environmental review processes are described and discussed in terms of how they may apply to the proposed SGP TC.

The review of regulatory and environmental review processes concludes that the SGP TC may generate significant public concern, and may have potentially significant adverse local and/or transboundary environmental effects. Therefore, it is likely that the SGP TC would be subject to review pursuant to *CEAA* and the *MVRMA* and the *Nunavut Land Claim Settlement Act* (*NLCSA*). It also is likely that the SGP TC would be subject to review by a (joint) panel.

1.6 Data Gaps

The scoping project involved the identification of information sources related to an environmental assessment of the SGP TC. Available documents were reviewed and noted as appropriate in sections of the report. Deficiencies related to specific VECs and VSCs are noted in the report. In general, the collection of site specific data will be required once a route or routes have been identified. All data sources are identified in this report, and in an additional volume which references data sources to topic areas.

LIST OF ACROYNYMS

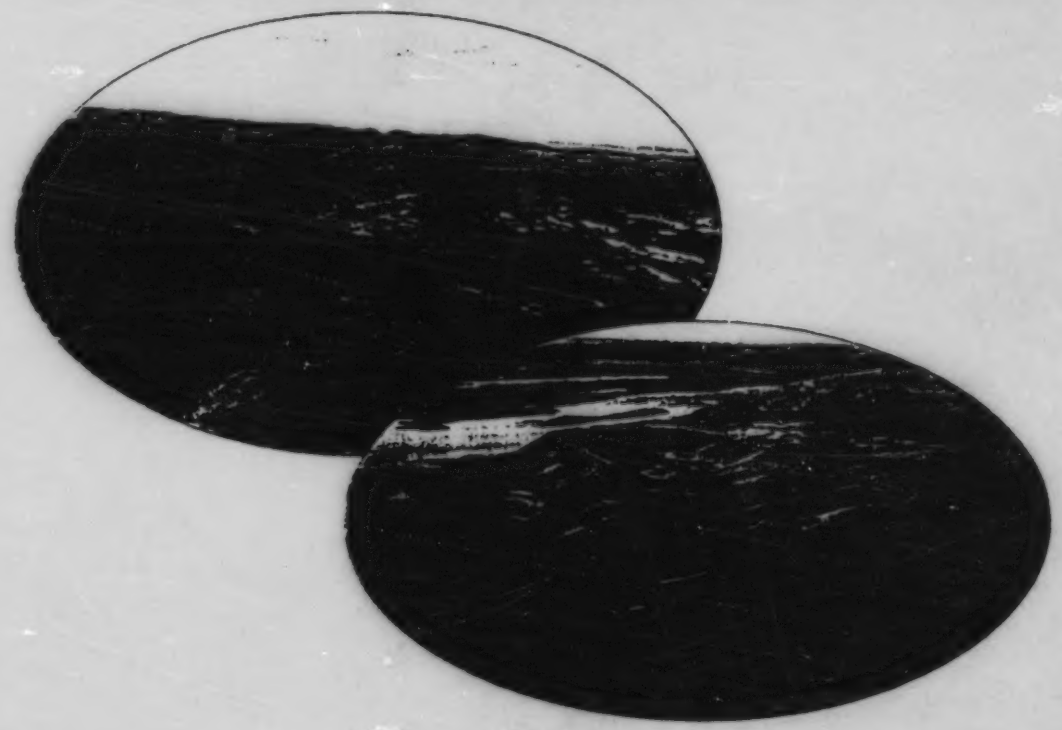
CEAA	*Canadian Environmental Assessment Act*
CEAA	Canadian Environmental Assessment Agency
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSR	Comprehensive Study Report
DIAND	Department of Indian Affairs and Northern Development
DOT	Department of Transportation
DFO	Department of Fisheries and Oceans
EIS	Environmental Impact Statement
GNWT	Government of the Northwest Territories
HTO	Hunters' and Trappers' Organization
KIA	Kitikmeot Inuit Association
KC	Kitikmeot Corporation
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVL&WB	Mackenzie Valley Land and Water Board
MVRMA	*Mackenzie Valley Resource Management Act*
NEB	National Energy Board
NGO	Non-Government Organization
NIRB	Nunavut Impact Review Board
NLCA	Nunavut Land Claim Agreement
NPC	Nunavut Planning Commission
NTI	Nunavut Tungavik Incorporated
NSMA	North Slave Metis Association
NWT	Northwest Territories
RA	Responsible Authority
ROW	Right-of-Way
SGP	Slave Geological Province
SGP TC	Slave Geological Province Transportation Corridor
TK	Traditional Knowledge
VEC	Valued Ecosystem Component
VSC	Valued Social Component
WKSS	West Kitikmeot Slave Study
WSC	Water Survey of Canada
YKDFN	Yellowknives Dene First Nation

B.5 Executive Summary of the Mapping and Route Analysis Study Slave Geologic Province Transportation Corridor

MULTI-LEVEL MAPPING & ROUTE ANALYSIS

Slave Geological Province Transportation Corridor

Volume 1 - Executive Summary



Arctic West Environmental Consultants Ltd
Lidia Plains Forest Consultants
Yellowknife Trust Association

MULTI-LEVEL MAPPING & ROUTE ANALYSIS
SLAVE GEOLOGICAL PROVINCE
TRANSPORTATION CORRIDOR

Volume 1 - Executive Summary

Prepared for:

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January 1999

Table of Contents

1.0 INTRODUCTION 1
- 1.1 Project Background 1
- 1.2 Project Objectives 1
- 1.3 Project Area Description 3

2.0 METHODOLOGY 4
- 2.1 Pre-Mapping Activities 4
- 2.2 Mapping and Aerial Photograph Interpretation 5

3.0 RESULTS AND DISCUSSION 14
- 3.1 Phase 1 - 1:250 000 Route Identification 14
- 3.2 Phase 2 - 1:60 000 Route Evaluation 14
  - 3.2.1 Work Area 1 14
  - 3.2.2 Work Area 2 17
  - 3.2.3 Work Area 3 18
  - 3.2.4 Work Area 4 19
  - 3.2.5 Work Area 5 21

4.0 RECOMMENDATION 22

List of Figures

Figure 1. Slave Geological Province General Transportation Corridor 2
Figure 2. Slave Geological Province Transportation Corridor, Selected Routes 15

List of Tables

Table 1. Geometric and Construction Cost Control Parameters 4
Table 2. Qualitative Ranking System for Aggregate Potential[1] 13
Table 3. Routes by Work Area based on 1:250 000 Analysis 14
Table 4. Statistical Summary of Routes within Work Area 1[1] 16
Table 5. Statistical Summary of Routes within Work Area 2[1] 18
Table 6. Statistical Summary of Routes within Work Area 3[1] 19
Table 7. Statistical Summary of Routes within Work Area 4[1] 20
Table 8. Statistical Summary of Routes within Work Area 5[1] 21
Table 9. Statistical Summary of Recommended Routes A-G-J-I[1] 22
Table 10. Statistical Summary of Recommended Routes T-U-B-A-G-J-I[1] 23

1.0 INTRODUCTION

1.1 Project Background

The ***Multi-level Mapping and Route Analysis, Slave Geological Province Transportation Corridor*** project is an initiative of the Department of Transportation, Government of the Northwest Territories. It is in response to interest in examining the feasibility of developing an all-seasonroad between the Yellowknife and Rae-Edzo areas in the south and Bathurst Inlet along the southern shore of the Arctic Ocean in the north (Figure 1).

For the purpose of this study, five distinct Work Areas were identified within the general transportation corridor as shown on Figure 1. The Work Areas include (approximate lengths of each route are shown in parenthesis):

(i) Work Area 1 Yellowknife area to Exeter Lake / Lac de Gras (~ 340 km),
(ii) Work Area 2 Exeter Lake / Lac de Gras to Contwoyto Lake / Lupin Mine area (~ 210 km),
(iii) Work Area 3 Contwoyto Lake / Lupin Mine area to Bathurst Inlet (~ 350 km),
(iv) Work Area 4 Rae-Edzo area to Colomac Mine / Snare Lake area (~ 200 km), and
(v) Work Area 5 Colomac Mine / Snare Lake area to Exeter Lake / Lac de Gras area (170 km)

This document is meant to provide an Executive Summary (Volume 1); it provides a summary of the detailed findings presented in both the Technical Report (Volume 2) and on the 1:60 000 Strip Mosaics (Volume 3).

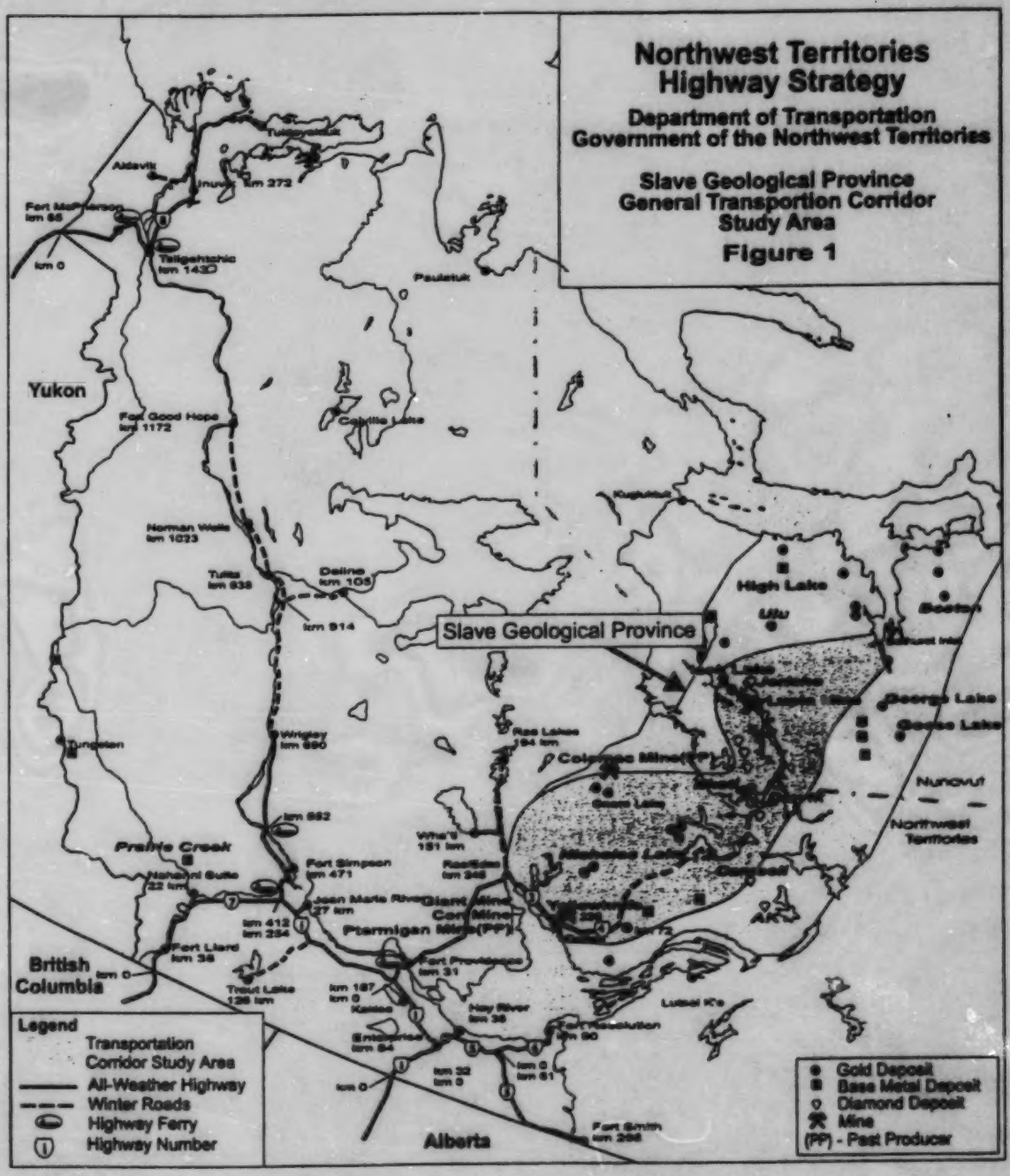
1.2 Project Objectives

Four specific phases were identified for the overall project. These include;

- Phase 1, Route Identification
  - identify three to five routes within each of the five Work Areas listed above on 1:250 000 NTS maps,

- Phase 2, Route Evaluation
  - conduct an analysis of 1:60 000 scale aerial photographs to obtain detailed information for each of the routes identified,

Figure 1. Slave Geological Province General Transportation Corridor



- Phase 3. Detailed Route Evaluation
  - further identification of specific routes from production and analysis of 1:10 000 and 1:20 000 scale air photos, and

- Phase 4. Route Refinement
  - refinement of Right-of-Way (ROW) location along specific or competing routes.

This report pertains solely to the identification of routes at 1:250 000 and the subsequent analysis of 1:60 000 aerial photographs (Phases 1 and 2). It does not deal with either the Detailed Route Evaluation (Phase 3) or the Route Refinement (Phase 4) phases of the project.

1.3 Project Area Description

The Slave Geological Province lies entirely within the Precambrian or Canadian Shield, the largest physiographic region recognized in the Northwest Territories (Figure 1). It runs north/northeast from Great Slave Lake in the south to the Bathurst Inlet/Coronation Gulf area in the north. It's boundaries are defined by three distinct fault lines, including the Bathurst Fault along the east, the McDonald Fault along the south and the Wopmay Fault along the west. The Bathurst Fault is highly visible along Bathurst Inlet.

Throughout its mainland portion, the Canadian Shield rarely exceeds elevations of 600 m above sea level (masl), with maximum relief generally limited to 60 - 70 m. Two major bedrock structural subdivisions occur within the Slave Geological Province that are of importance to the transportation corridor; these include (1) Archean-age igneous intrusives and (2) Yellowknife Supergroup supracrustal strata, the former being more favorable for road construction and bed.

Bedrock materials are generally overlain by a thin cover of sandy till materials. In some areas, undulating bedrock materials predominate. Esker and to a lesser extent, kame complexes are scattered throughout the Slave Geological Province; the incidence of esker deposits is greater in the northern areas (i.e. north of Lac de Gras). Deglacially enlarged lake basins (i.e. Yellowknife and Drybones lakes) and localized ponding of ice-dammed waters generated thin glaciolacustine deposits throughout the study region. Patterned bogs, ribbed fens, and swampy terrain (of varied thickness) mantle large portions of the present landscape because of low relief and slow drainage, and thin surficial deposits overlying undulating bedrock.

2.0 METHODOLOGY

2.1 Pre-Mapping Activities

Upon award of the contract, project personnel met with the Department of Transportation, Government of Northwest Territories in Yellowknife to review the project Terms of Reference and to obtain background materials that were in the possession of the Department (i.e. 1:50 000 NTS maps, bedrock geology maps, etc). Members of the project team reviewed existing information (Douglas *et. al.* 1973, Fraser 1972 and 1992, Frith 1993, Henderson 1985, McGlynn 1977, Mollard 1997, Aylsworth and Shilts 1989, and Dredge *et. al.* 1995) and pre-selected a route to fly through Yellowknife - Exeter Lake - Contwoyto Lake - Bathurst Inlet - Burnside River - Contwoyto Lake - Snare Lake - Rae-Edzo - Yellowknife. Members of the project team flew this route on August 20, 1998. Selected oblique photographs are shown on subsequent pages.

Geometric and construction cost control parameters were reviewed prior to any mapping activities to ensure that all project personnel were consistent in mapping. The following parameters (Table 1) were considered in selecting and defining routes:

Table 1. Geometric and Construction Cost Control Parameters

Criteria	Implications
Topography	Route location should have little to no right-of-way excavation; embankment construction should average 0.5 to 1.5 m in thickness (vertical and horizontal alignment considerations).
Bedrock surface	Route location should follow glacier-smooth surfaces with micro relief of 1.0 m or less.
Lakes	Vertical and horizontal alignment considerations.
River crossings	Route should minimize river crossings and locate crossings that are narrows and on suitable foundation conditions.
Wet organic terrain	Route location should avoid seasonally wet or permanent organic terrain wherever practical.
Granular borrow sources	Route location should consider location, volume and composition of potential sources (i.e. esker complexes)
Permafrost	Not considered a major factor in route location as entire area is zone of permafrost

2.2 Mapping and Aerial Photograph Interpretation

A combination of 1:250 000 and 1:50 000 NTS maps with 20 m and 10 m contours respectively were used in the Route Identification phase of the project. These maps show hydrology, limited surficial materials (eskers and occasional sand deposits, wetlands), and major access routes (i.e. Hwy 4, major winter highways, etc.). Project personnel began working south from the proposed Bathurst Inlet site (66°32' 30" north latitude and 107° 31' 00" west longitude) as shown within the Nuna Logistics report (Smith and Tice 1998). Every attempt was made to conform to the geometric and construction control parameters presented above (in Table 1) as well as align proposed routes and adjoining segments "within contours" as opposed to "crossing contours".

Following the approval of the 1:250 000 Route Identification phase of the project by the Department of Transportation (September 10, 1998), 1:60 000 black and white aerial photographs from between 1953 and 1957 were obtained from the National Air Photo Library in Ottawa, Ontario. Two sets of photography were obtained; one set was required for route refinement and interpretation of surficial materials, slope, and drainage, while the other set was used to produce the north/south strip mosaics. Individual aerial photographs were interpreted to refine route placement and to delineate terrain units at the 1:60 000 scale. Minimum terrain unit size was 1 cm^2, an area equivalent to 36 ha (89 ac). No field work was undertaken to support this interpretation Each terrain unit was given a unique terrain classification call as per the following example:

$$\frac{Mvb^{(1)} / Ru^{(2)} - S^{(3)}}{6 - 9^{(4)}}$$
$$m^{(5)}$$

where (1) Mvb represents morainal veneers and blankets (2) / Ru represents approximately 40 % undulating bedrock, (3) S, represents modifying process, solifluction, (4) 6 - 9, represents the slope class, 6 - 9 %, and (5) m, represents the drainage classes, moderate.

All terrain classification used coding (as shown above) as per the standards presented within the Canadian System of Soil Classification, Second Edition (1987). A terrain classification legend is provided on each strip mosaic.

A total of 64 uncontrolled north/south strip mosaics were produced following the delineation and refinement of routes on the 1:60 000 aerial photographs. Line work from the 1:60 000 aerial photographs was transferred to the uncontrolled mosaics using a combination of stereo transfer techniques. Following the creation of individual mosaics, individual routes were digitized in Microstation SE software with one kilometer interval

Plate 1. **Rugged, low-relief Archean granites east of Yellowknife near terminus of Ingraham Trail.**

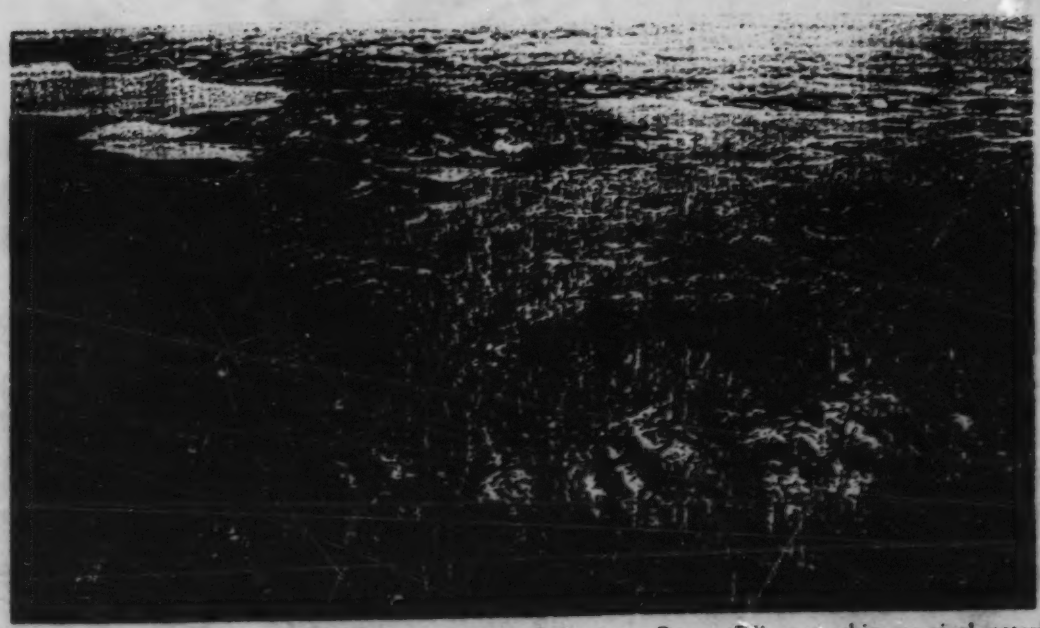


Plate 2 **Low-relief bedrock hummocks adjacent Spencer Lake (near Route 'D'), note thin morainal materials interpersed between bedrock hummocks. Drainage varies from rapid (on hummocks) to moderately well and imperfect.**

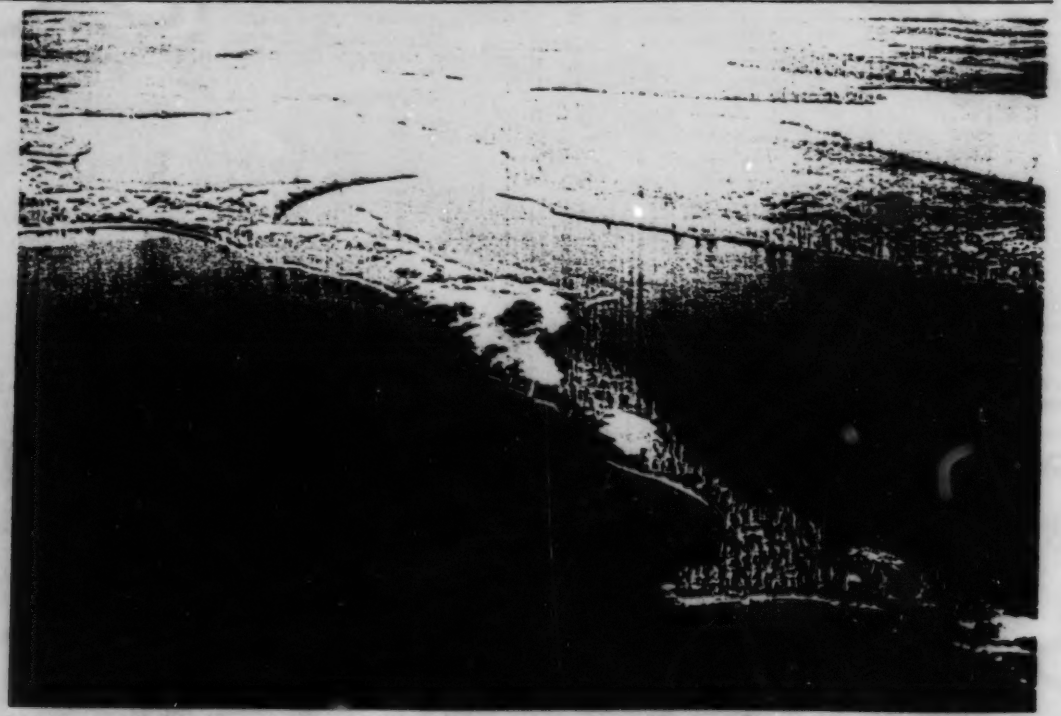


Plate 3. Significant esker landform jutting into Rivett Lake near junction of Routes 'C' and 'V'. Materials appear to be sand-dominated.

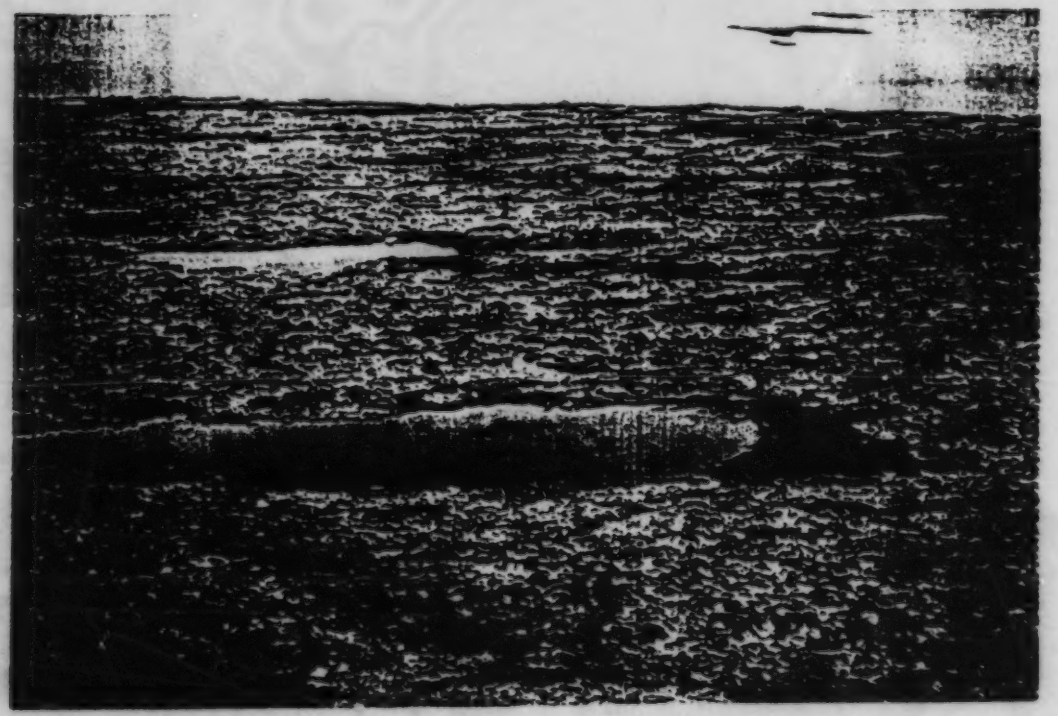


Plate 4 Boulder field near Outram Lake east of Route 'V' and Mackay lake

Plate 5. Patterned ground east of Lake MacKay. Note highly variable drainage conditions and large wetland area along right side of photograph.

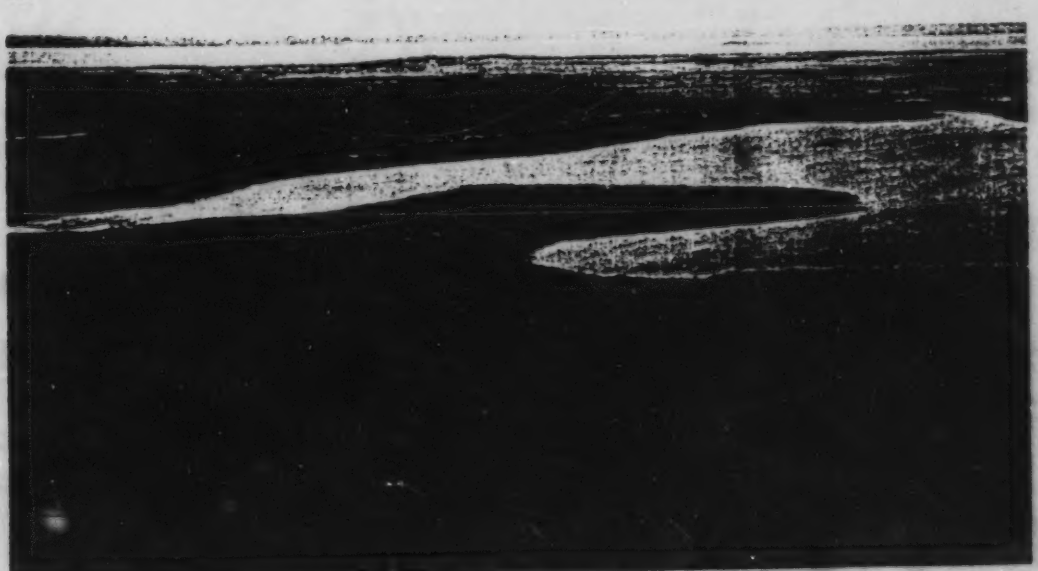


Plate 6. Highly favorable topography in the Ghurka Lake area near Route 'H'. Slopes are less than 5 % within morainal materials of variable thickness overlying gently undulating bedrock.

Plate 7. Large esker feature adjacent Mara River. Note coarse-textured nature of deposit.

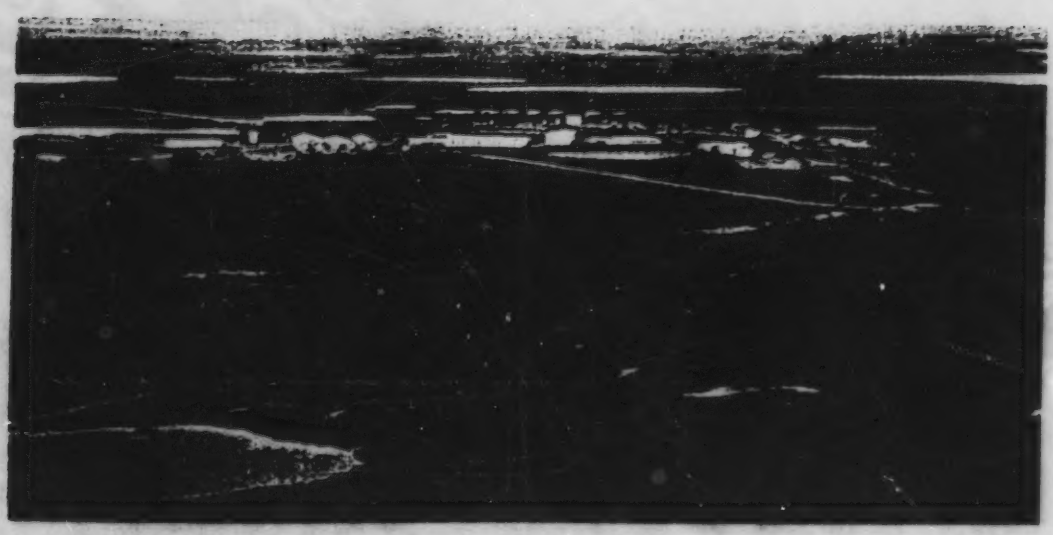


Plate 8 Lupin Mine Site.

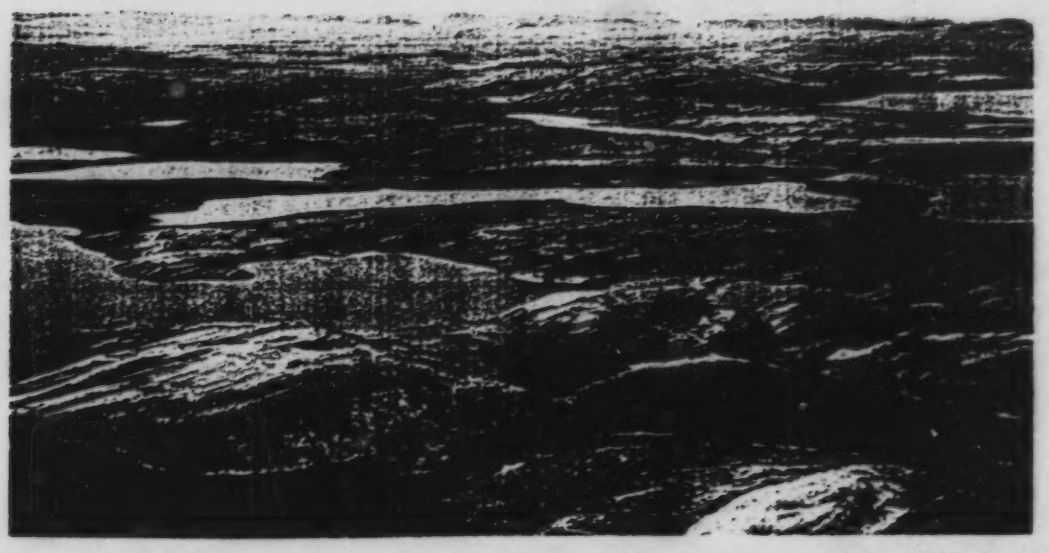


Plate 9. Unfavorable topography near Bathurst Inlet Area. Thin morainal materials overly undulating bedrock.

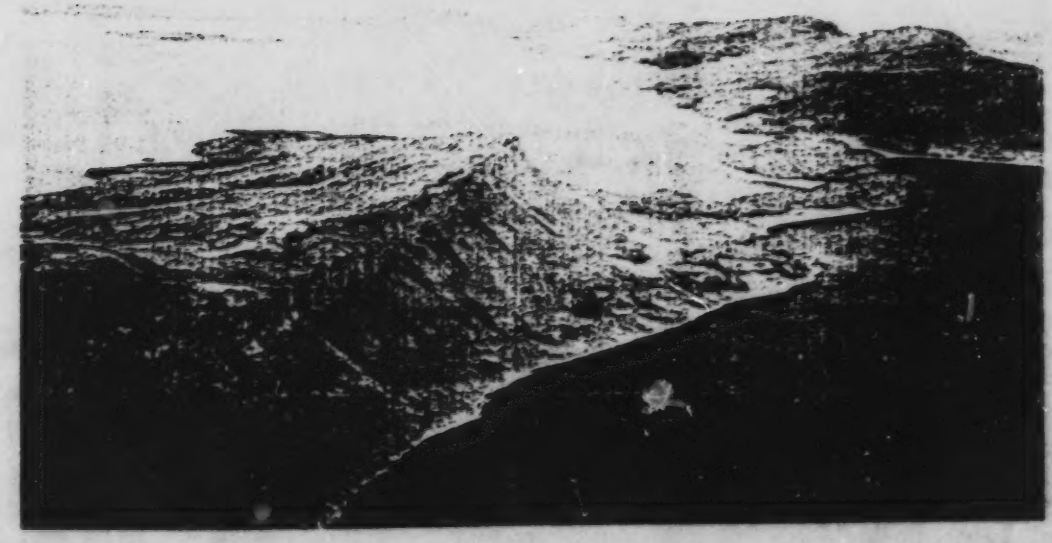


Plate 10. Bathurst Inlet area

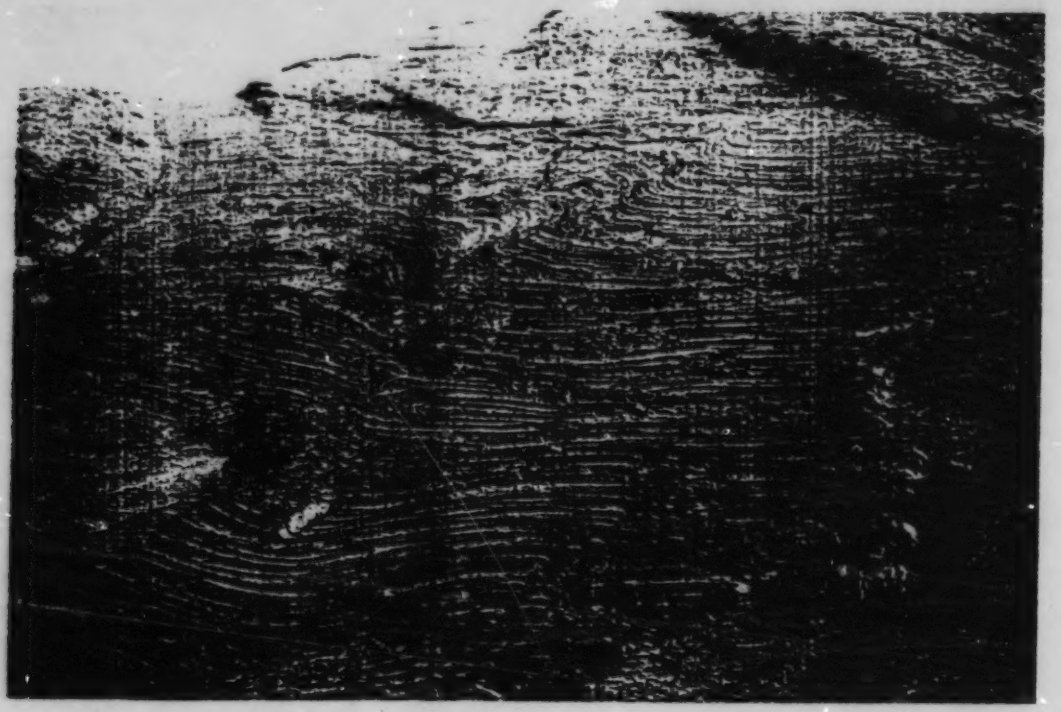


Plate 11. Stratified marine sediments adjacent Bathurst Inlet. These deposits are found west of the proposed port site along an unnamed stream on Route 'I'

Plate 12. Sand complex along Route 'P' near Snare Lakes. These materials will provide a good source of aggregate for road construction.

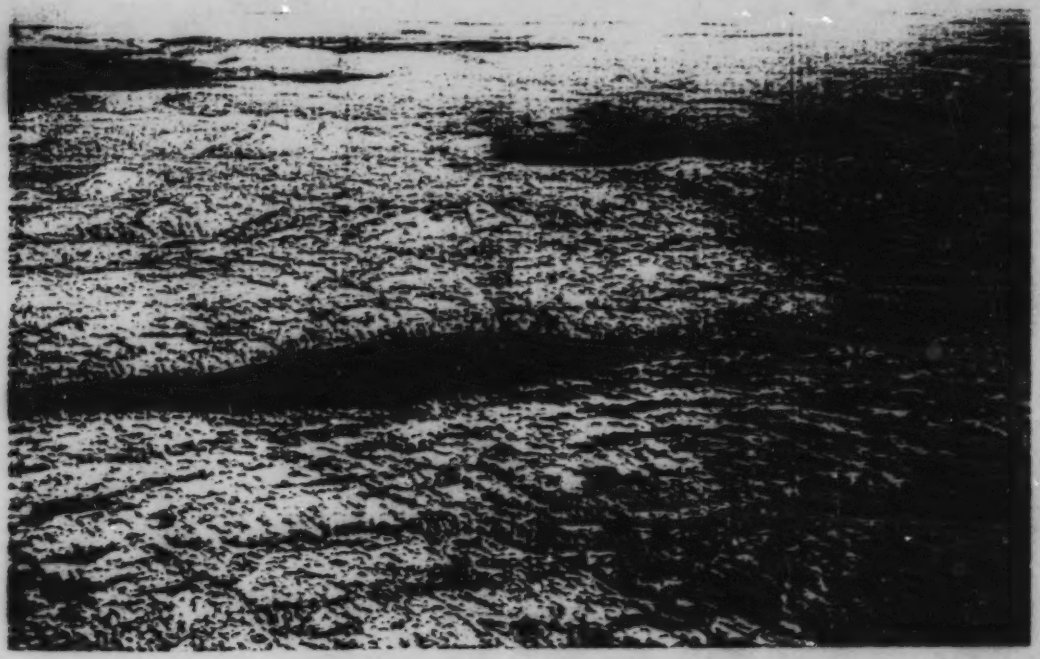


Plate 13 Moderate-relief, unfavorable bedrock 35 km north of Rae-Edzo. No aggregate sources are found within this area

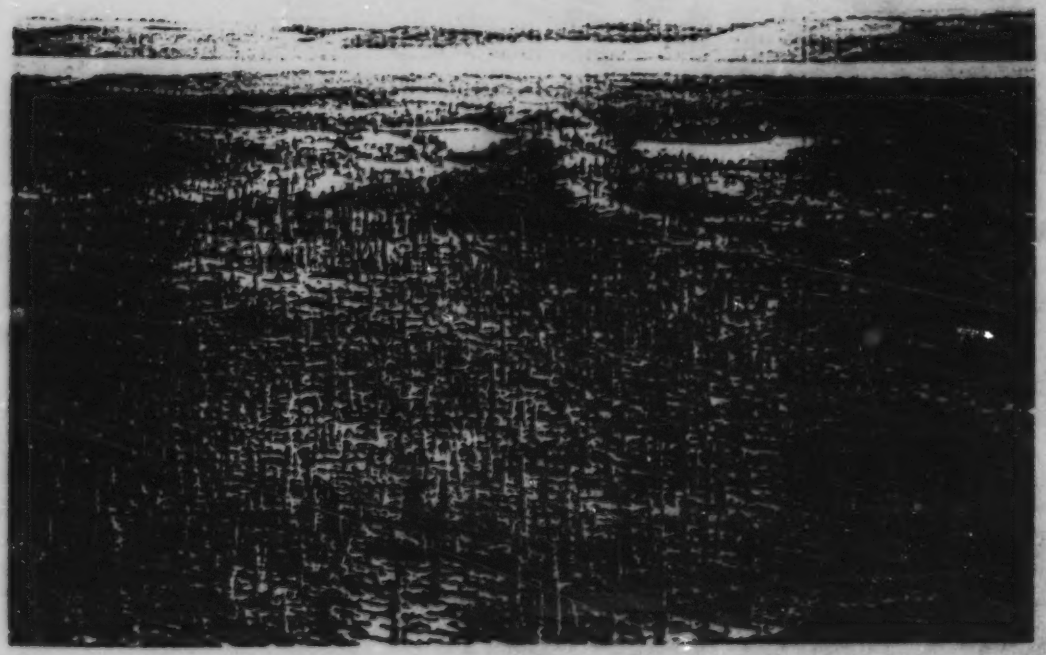


Plate 14 Large esker complex adjacent Roundrock Lake. Route 'P' parallels Roundrock Lake

markers being generated for each route. Controlled mosaics should be created for Phase 3 and 4 activities.

Summary tables were prepared to summarize landform, slope, bridge and curve information for each route. All measurements were taken directly from the uncontrolled mosaics, hence the distances should be considered "approximate". A qualitative assessment of aggregate potential (Table 2) for each segment and route was provided within the summary tables.

Table 2. Qualitative Ranking System for Aggregate Potential[1]

Rating Scale	Description
Nil	No eskers or glaciofluvial deposits were mapped within the segment route on the 1:60 000 aerial photographs
Poor	Very few eskers or glaciofluvial deposits were noted along the segment route on the 1:60 000 aerial photographs; eskers may be poorly spaced along route, for example, all eskers are grouped at one end of the segment route.
Good	A significant number of eskers were noted along the segment route on the 1:60 000 aerial photographs; these esker deposits are evenly distributed along the segment route and are comprised mainly of sand.
Excellent	Significant esker and glaciofluvial deposits in the form of outwash plains were mapped on the 1:60 000 aerial photographs; these deposits are evenly distributed along the segment route and are comprised of a combination of sand, gravels, cobbles and boulders

1. All ratings have been developed from a review of the 1:60 000 black and white aerial photographs. A flight by the individuals undertaking the routing on August 20, 1998 suggested that most of the eskers are sand-based, however, no observations were made on texture of eskers at depth.

3.0 RESULTS AND DISCUSSION

3.1 Phase 1 - 1:250 000 Route Identification

Table 3 presents the total number of routes identified within each of the five Work Areas based upon the analysis of 1:250 000 and 1:50 000 NTS maps and background data and maps. These routes are depicted on Figure 2.

Table 3. Routes by Work Area based on 1:250 000 Analysis

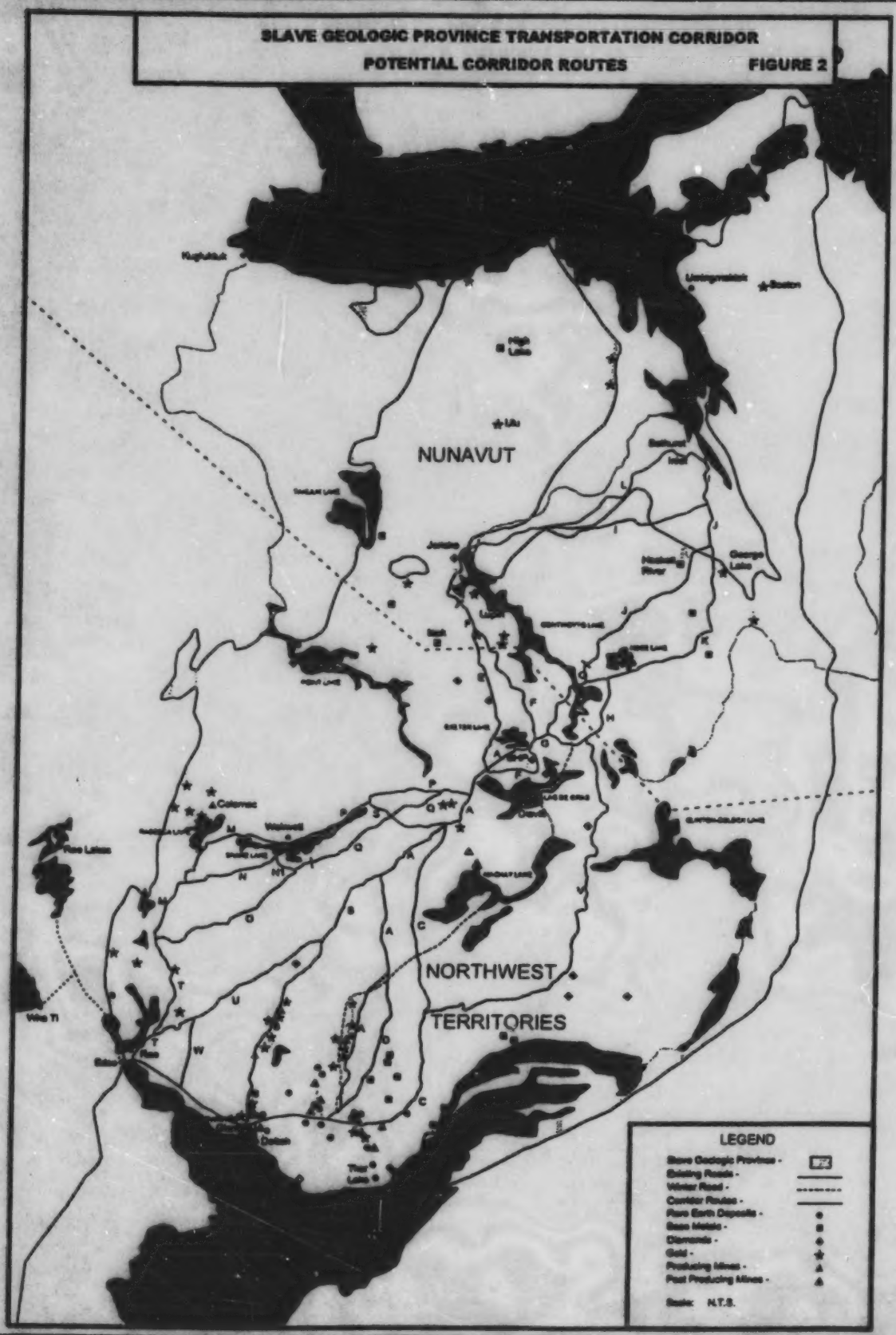
Work Area		Number of Routes	Route Identification
1	Yellowknife Area to Exeter Lake/Lac de Gras	5	A, B, C, D and V
2	Exeter Lake/Lac de Gras to Contwoyto Lake/Lupin Mine	4	E, F, G, and H
3	Contwoyto Lake/Lupin Mine to Bathurst Inlet	4	I, J, K, and L
4	Rae-Edzo to Colomac Mine/Snare Lake	6	M, N, O, T, U and W
5	Colomac Mine/Snare Lake to Exeter Lake/Lac de Gras	4	P, Q, R, and S

3.2 Phase 2 - 1:60 000 Route Evaluation

Based upon the review of 1:60 000 black and white aerial photographs and selected 1:125 000 surficial geology maps, the following recommendations have been developed for each Work Area. Distances for each route are not presented as route distance is not comparable between routes (i.e. Route 'B' joins Route 'A' to get from Yellowknife to Exeter Lake).

3.2.1 Work Area 1

The Yellowknife to Exeter Lake segment is approximately 340 km in length (direct line distance). Elevations increase from 160 m adjacent Great Slave Lake to 439 m at Exeter Lake. J.D. Mollard and Associates (1997) identified four possible routes (A, B, C and D) within the Yellowknife to Exeter segment; Route "V" was subsequently added to this Work Area. Route "A" appears to be the most favorable of the five routes as there is a greater incidence of the more favorable Archean granites and granodiorites and a higher number of esker complexes, especially within the northern segment of this proposed route. The other four routes


SLAVE GEOLOGIC PROVINCE TRANSPORTATION CORRIDOR
POTENTIAL CORRIDOR ROUTES
FIGURE 2
NUNAVUT
NORTHWEST
TERRITORIES
LEGEND
Slave Geologic Province -
Existing Roads -
Winter Road -
Corridor Routes -
Rare Earth Deposits -
Base Metals -
Diamonds -
Gold -
Producing Mines -
Past Producing Mines -
Scale: N.T.S.

have more significant limitations, including a greater incidence of less favorable Yellowknife Supergroup bedrock, fewer and smaller eskers, increased number of stream crossings (i.e. Route "B" and "V"), and quite often greater distances (i.e. Route "C" and "V"). Table 4 summarizes presents a summary of the total distance (of each individual route), the number of bridge crossings, curves, a qualitative assessment of aggregate potential and the percentage of proposed route by slope class for routes within Work Area 1.

Table 4. Statistical Summary of Routes within Work Area 1[1]

Route	Total[2] Distance (km)	Number of Bridge Crossings	Bridge Crossings every (km)	Major Curve every (km)	Aggregate Potential	Percentage of Proposed Route by Slope Class			
						< 10	10 - 15	16 - 30	> 30
A	337	3	112	7	poor	83	11	3	3
B	220	7	29	5	poor	81	10	4	4
C	272	7	39	4	poor	64	18	16	3
D	140	4	35	4	poor	76	15	3	6
V	289	9	32	7	good	73	20	5	1

[1] Statistics have been rounded; distances calculated through Microstation software.

[2] Total distance represents total length of individual route segments; these measurements do not, in most cases, represent the total distance between Yellowknife/Ingraham Trail Terminus and the Exeter Lake/Lac de Gras area (only Route segment 'A' presents the total distance).

Recommendations

(1) Based upon the review of 1:60 000 aerial photographs and background data, it is recommended that Route "A" be flown to acquire 1:10 000 and 1:20 000 aerial photography for further route refinement. This combined route will allow a direct path to be established between the Ingraham Trail terminus and the Exeter Lake / Lac de Gras area. The total route would be approximately 337 kilometers in length. Approximately 94 % of the proposed path resides upon favorable topography (slopes less than 15 %). Compared to the three other major routes, Route "A" is clearly the straightest; containing a major curve only every 7.2 kilometers (on average). In addition, it is expected that Route "A" will be the least costly to construct because only three (3) bridges are required. A small segment, known as "A3" should be flown because it offers a shorter, more linear path to Starfish Lake, in addition to containing a very high percentage (98 %) of very low relief terrain along the route.

(2) It is also recommended that Route "B" be flown to acquire 1:10 000 and 1:20 000 aerial photography for further route refinement. This route will allow a direct path to be established northward between Yellowknife and Exeter Lake / Lac de Gras (utilizing the northernmost portion of Route "A"). The combined route ('B' and northern portion of 'A') would be approximately 264 kilometers in length. Approximately 91 % of the proposed path resides upon favorable topography (slopes less than 15 %). Route "B" has a higher number of stream crossings (7) than 'A'; this is expected to make it more costly to construct. However, the initial 36 % of Route "B" (to Giauque Lake) would follow an existing hydro corridor (with service roads). This is expected to drastically reduce construction costs, as well as limit additional environmental impacts within the initial 94 kilometers of the new highway. In addition, Route "B" offers a more linear path (major curve every 4.9 kilometers) than Route 'A'.

3.2.2 Work Area 2

The Exeter Lake / Lac de Gras - Contwoyto Lake / Lupin Mine segment is approximately 210 km in length. Elevations range from a low of 439 m at Exeter Lake to 620 m atop the Peacock Hills to the north; most of the topography is less than 525 m. Four (4) possible routes (E, F, G and H) have been identified between Exeter Lake the Contwoyto Lake / Lupin Mine area. The first two routes (E and F) run north from Exeter Lake to the west of Contwoyto Lake to the Lupin Mine area; the remaining two routes (G and H) run northeast from Exeter Lake to Pellatt Lake and the south end of Contwoyto Lake (G) and from Exeter Lake towards Ghurka Lake. Table 5 summarizes presents a summary of the total distance (of individual routes), the number of bridge crossings, curves, a qualitative assessment of aggregate potential and the percentage of proposed route by slope class for routes within Work Area 2.

Recommendations

(1) It is recommended that 1:10 000 and 1:20 000 photography be acquired for Route "G". Route "G" is preferred to Route "H" as it is shorter in length (78 versus 105 km). Furthermore, Route "G" lies upon more favorable low-relief topography with 90 % of the slopes being less than 15 %; in comparison, only 74 % of the topography along Route "H" is less than 15 %. Route "G" also provides immediate access to the Contwoyto Lake Winter Road north of Pellatt Lake. Only two bridges would need to be constructed along Route "G" (as opposed to seven required for Route "H"). Both routes are considered to have poor aggregate potential.

Table 5. Statistical Summary of Routes within Work Area 2[1]

Route	Total[2] Distance (km)	Number of Bridge Crossings	Bridge Crossings every (km)	Major Curve every (km)	Aggregate Potential	Percentage of Proposed Route by Slope Class			
						< 10	10 - 15	16 - 30	> 30
E	128	1	128	4	poor	55	40	3	2
F	209	7	30	5	good	84	14	2	0
G	78	2	39	4	poor	45	50	4	1
H	100	7	14	4	good	65	10	17	9

[1] Statistics have been rounded; distances calculated through Microstation software.

[2] Total distance represents total length of individual route segments; these measurements do not represent the total distance between the Exeter Lake/Lac de Gras area and the Lupin Mine area.

(2) If it is warranted to have an all-season road running along the western side of Contwoyto Lake to access the Lupin Mine site, it is recommended that Route "F" be flown to acquire 1:10 000 and 1:20 000 photography. A comparison of Routes "E" and "F" suggests that Route "F" is preferred especially with regards to suitable low-relief topography. Approximately 98.4 % of Route "F" occurs on topography less than 15 %, of which 84.5 % is less than 10 %. Aggregate potential is considered good for Route "F" (as opposed to Route "E" which is considered poor). The major drawback of Route "F" however, is the number of bridges that would need to be constructed.

3.2.3 Work Area 3

The Contwoyto Lake / Lupin Mine to Bathurst Inlet segment varies from 180 - 350 km in length (depending upon which route segment is chosen). Elevations range from approximately 480 m near the southeast corner of Contwoyto Lake to sea level at Bathurst Inlet. The most rugged topography is found in the Bathurst Inlet/Bathurst Lake area where volcanic intrusions extend approximately 200 m. above sea level. Four routes (I, J, K and L) have been evaluated. Route "I" is thought to be the best route if a route is chosen to go around the north end of Contwoyto Lake to Bathurst Inlet; this route provides good access to the Lupin mine and the Jericho and Izok Lake deposits. Routes "J" and "K" are equally "good" routes if access is required form the south end of Contwoyto Lake. Route "K" is somewhat longer than "J" as it swings further to the south and east to provide access to both Hackett River and George Lake/Goose lakes projects. Table 6 presents a summary of the total distance (of individual routes), a summary of the number of bridge crossings, curves, a qualitative assessment of aggregate potential and the percentage of proposed route by slope class for routes within Work Area 3.

Table 6. Statistical Summary of Routes within Work Area 3[1]

Route	Total[2] Distance (km)	Number of Bridge Crossings	Bridge Crossings every (km)	Major Curve every (km)	Aggregate Potential	Percentage of Proposed Route by Slope Class			
						< 10	10 - 15	16 - 30	> 30
I	344	14	25	3	poor	73	6	8	13
J	171	1	171	3	good	50	22	18	10
K	162	4	40	4	good	33	42	14	11
L	179	5	36	3	good	86	7	3	3

[1] Statistics have been rounded; distances calculated through Microstation software.

[2] Total distance represents total length of individual route segments; these measurements do not represent the total distance between the Lupin Mine area and Bathurst Inlet.

Recommendations

(1) It is recommended that Route "J" and selected portions of Route "I" (kilometers 0 - 64) be flown to acquire 1:10 000 and 1:20 000 aerial photography for further route refinement. This route will allow a direct route to be established between the south end of Contwoyto Lake and the proposed Bathurst Inlet port site. This route would be approximately 235 km in length of which nearly 75 % of the proposed route has favorable topography (slopes less than 15 %) with aggregate potential being considered "good" throughout most of the route.

(2) If it is warranted to have an all-season road running from the Lupin Mine site north around Contwoyto Lake to Bathurst Inlet, then it is recommended that Route "L" be flown at 1:10 000 and 1:20 000. While Route "L" presents a viable alternative to Route "J" (to the south), the topography in and near (especially along the northern end of) Contwoyto Lake would be extremely difficult to construct a road. The topography becomes considerably more favorable east of the Peacock Hills.

3.2.4 Work Area 4

The Rae-Edzo to Colomac Mine / Snare Lake segment is approximately 200 km in length. Elevations range from 213 m southwest of Bigspruce Lake to approximately 437 m northeast of the Colomac Mine site. Six (6) routes were identified, including routes "M", "N", "O", "T", "U" and "V". Table 7 presents a summary of the total distance (of individual routes), the number of bridge crossings, curves, a qualitative assessment of aggregate potential and the percentage of proposed route by slope class for routes within Work Area 4.

Table 7. Statistical Summary of Routes within Work Area 4[1]

Route	Total[2] Distance (km)	Number of Bridge Crossings	Bridge Crossings every (km)	Major Curve every (km)	Aggregate Potential	Percentage of Proposed Route by Slope Class			
						< 10	10 - 15	16 - 30	> 30
M	170	5	34	4	poor	78	16	4	3
N	61	2	30	5	good	70	22	3	4
O	131	4	33	6	poor	85	9	3	2
T	84	2	42	6	nil	80	15	2	4
U	194	5	39	6	poor	73	14	7	6
W	32	2	16	5	poor	75	24	1	-

[1] Statistics have been rounded; distances calculated through Microstation software.

[2] Total distance represents total length of individual route segment; these measurements do not represent the total distance between the Rae-Edzo area to Colomac Mine / Snare Lake area.

Recommendations

(1) If it is preferred to have a route between Rae-Edzo and the Colomac Mines/Snare Lake area, it is recommended that routes "T", "O", a portion of "N" be flown to acquire 1:10 000 and 1:20 000 aerial photography for further route refinement. Route "O" (with Route "N1" and eastern portion of Route "N") is preferred over either Route "M" or western "N" because of its' more linear path, fewer bridge crossings, and high percentage (85.5 %) of low relief (0 - 10 %) topography.

(2) If a route is preferred between the Rae-Edzo area northeast to the Lac de Gras, it is recommended that Route "U"/"W" be flown to acquire 1:10 000 and 1:20 000 aerial photography for further route refinement. This combined route will allow a more direct and shorter path to be established between Rae-Edzo and the Lac de Gras/Exeter Lake area than any of the other routes identified within Work Areas 4 and 5. The total route would be approximately 226 kilometers in length (194 kilometers along Route "U" and 32 kilometers along Route "W").

3.2.5 Work Area 5

The Colomac Mine / Snare Lake to Lac de Gras/Exeter Lake segment is approximately 170 km in length. Elevations range from 355 m at both Snare and Roundrock lakes to 439 m at Exeter Lake. Four (4) routes (P, Q, R, and S) have been identified between the Colomac Mine / Snare Lake area and Exeter Lake. Routes "P" and "Q" both appear to be "good" routes, however Route "P" occurs along the north side of Snare Lake, while Route "Q" is to the south of the lake. Both offer "good" potential aggregate sources. The two smaller routes, "R" and "S" represent segments between "P" and "Q" to a more southerly junction with Route "A". Both of these routes also appear to have "good" potential for aggregate. Table 8 presents a summary of the total distance (of individual routes), the number of bridge crossings, curves, a qualitative assessment of aggregate potential and the percentage of proposed route by slope class for routes within Work Area 5.

Table 8. Statistical Summary of Routes within Work Area 5[1]

Route	Total[2] Distance (km)	Number of Bridge Crossings	Bridge Crossings every (km)	Major Curve every (km)	Aggregate Potential	Percentage of Proposed Route by Slope Class			
						< 10	10 - 15	16 - 30	> 30
P	171	2	85	6	excellent	83	12	3	2
Q	144	3	48	4	good	77	14	7	3
R	67	-	67	5	good	87	3	8	2
S	31	1	31	16	excellent	73	17	3	6

[1] Statistics have been rounded; distances calculated through Microstation software.

[2] Total distance represents total length of individual route segments; these measurements do not represent the total distance between the Colomac Mine / Snare Lake area and the Exeter Lake / Lac de Gras area.

Recommendations

(1) Within Work Area 5 (Colomac Mines/Snare Lake - Lac de Gras/Exeter Lake region) it is recommended that Route "P" be flown to acquire 1:10 000 and 1:20 000 aerial photography for further route refinement. Route "P" is preferred over routes "Q", "R", and "S" (relevant portions only) because of its' few bridge crossings, linear path, excellent potential aggregate resources, and high percentage (83.5 %) of low relief (0 - 10 %) topography.

4.0 RECOMMENDATION

The recommendations provided below are based upon the analysis of 1:250 000 and 1:50 000 NTS maps and detailed terrain mapping of 1:60 000 aerial photographs.

(1) If a route is required between the Yellowknife area in the south and the Bathurst Inlet area in the north, then it is recommended that routes ***A - F - H - G - J - I*** be followed. These routes provide the most direct and shortest distance (715 km) between the Yellowknife area and the Bathurst Inlet area, and access to Contwoyto Lake and adjacent mine sites and mineral deposits (i.e. via winter roads, barges, etc.). In addition, these routes occur on the most favorable topography, have poor to good aggregate sources (south to north, respectively), and have the fewest number of bridge crossings. A statistical summary for this proposed route is found in Table 9.

Table 9. Statistical Summary of Recommended Routes A - F - H - G - J - I [1]

Route	Distance (km)	Number of Bridge Crossings	Bridge Crossings every (km)	Major Curve every (km)	Aggregate Potential	Percentage of Proposed Route by Slope Class			
						< 10	10 - 15	16 - 30	> 30
A	337	3	112	7	poor	83	11	3	3
F[4]	55	2	27	3	good	70	29	1	0
H[4]	10	0	0	2	nil - poor	25	0	57	18
G	78	2	39	4	poor	45	50	4	1
J	171	1	171	3	good	50	22	18	10
I[2]	64	5	13	2	nil[3]	90	7	0	3
Total	715	13	55	4	-	68	22	6	4

[1] Statistics have been rounded; distances calculated through Microstation software.
[2] Figures presented for Route I are only between it's junction with Route J and proposed Bathurst Inlet terminal.
[3] Although Route "I" has been rated as poor for aggregate, this particular segment is considered to have no potential for aggregate (at the 1:60 000 scale).
[4] Figures presented for routes F, and H are for those segments required to join various segments and do not represent total lengths.

(2) If a route initiating at or near Rae-Edzo is desired, then routes ***T - U - B - A - F - H - G - J - I*** is recommended. These routes provide the most direct and shortest distance between the Rae-Edzo area and the Bathurst Inlet area (781 km), and access to Contwoyto Lake and adjacent mine sites (i.e.

via winter roads, barges, etc.). A statistical summary of this proposed route is found in Table 10.

Table 10. Statistical Summary of Recommended Routes T - U - B - A - F - H - G - J - I [1]

Route	Distance (km)	Number of Bridge Crossings	Bridge Crossings every (km)	Major Curve every (km)	Aggregate Potential	Percentage of Proposed Route by Slope Class			
						< 10	10 - 15	16 - 30	> 30
T[2]	15	1	15	1	nil	80	15	2	4
U	194	5	39	6	poor	73	14	7	6
B[2]	52	3	17	9	good	91	4	3	2
A[2]	142	1	93	7	good	93	3	4	0
F[2]	55	2	27	3	good	70	29	1	0
H[2]	10	0	0	2	nil - poor	25	0	57	18
G	78	2	39	4	poor	45	50	4	1
J	171	1	171	3	good	50	22	18	10
I[2]	64	5	13	2	nil[3]	90	7	0	3
Total	781	20	39	6	-	75	16	5	4

[1] Statistics have been rounded; distances calculated through Microstation software.
[2] Figures presented for routes A, B, F, H, I and T are for those segments required to join various segments and do not represent total lengths.
[3] Although Route "I" has been rated as poor for aggregate, this particular segment is considered to have no potential for aggregate (at the 1:60 000 scale).

(3) Block photography should be acquired for a number of areas, including all major water crossings (i.e. Mara River, Snare River, etc.) and the Bathurst Inlet area where the proposed route terminates.

B.6 Summary of the Cost Estimates Study Slave Geologic Province Transportation Corridor

SLAVE GEOLOGIC PROVINCE
TRANSPORTATION CORRIDOR

COST ESTIMATES

Prepared by:
Highways and Engineering Division
Department of Transportation

MAY 1999

TABLE of CONTENTS

Page

Introduction 1

Study Area 3

Design Parameters 3

Qualitative Ranking For Aggregate Potential 4

Estimated Roadway Quantities 5

Estimated Unit Costs 5

Average Cost Per Kilometre 6

Stream Crossing/Drainage And Engineering Costs 6

Theoretical Routes - Estimated Construction Costs 8

Conclusion 9

FIGURE 1 Potential Corridor Routes 2

FIGURE 2 Typical Design Cross-section 4

TABLE 1. Estimated Roadway Quantities 5

TABLE 2. Estimated Unit Costs 6

TABLE 3. Estimated Average Embankment Construction Costs per kilometre (Based on Aggregate Potential) 6

TABLE 4. Estimated Stream Crossing/Drainage and Engineering costs 7

TABLE 5. Estimated Construction Costs 8

INTRODUCTION

The Slave Geologic Province Transportation Corridor is an strategic initiative of the Department of Transportation, Government of the Northwest Territories, in providing an all-weather transportation route, between the north shore of Great Slave Lake in the south and Bathurst Inlet to the north, to promote mineral exploration and development within the Slave Geologic Province. This report is one of three other studies that was undertaken by the Department of Transportation for the Slave Geologic Province Transportation Corridor to assist with future planning and decision making. The three specific studies include: Multi-level Mapping and Route Analysis; Environmental Scoping, Existing Data Collection, and Regulatory Identification; and a Corridor Need/Feasibility Study.

This report presents cost estimates that were prepared for the potential transportation routes (see figure 1), through the Slave Geologic Province, as identified by Taiga Plains Forest Consultants/Geowest Environmental Consultants Ltd. in their Multi-level Mapping and Route Analysis study.

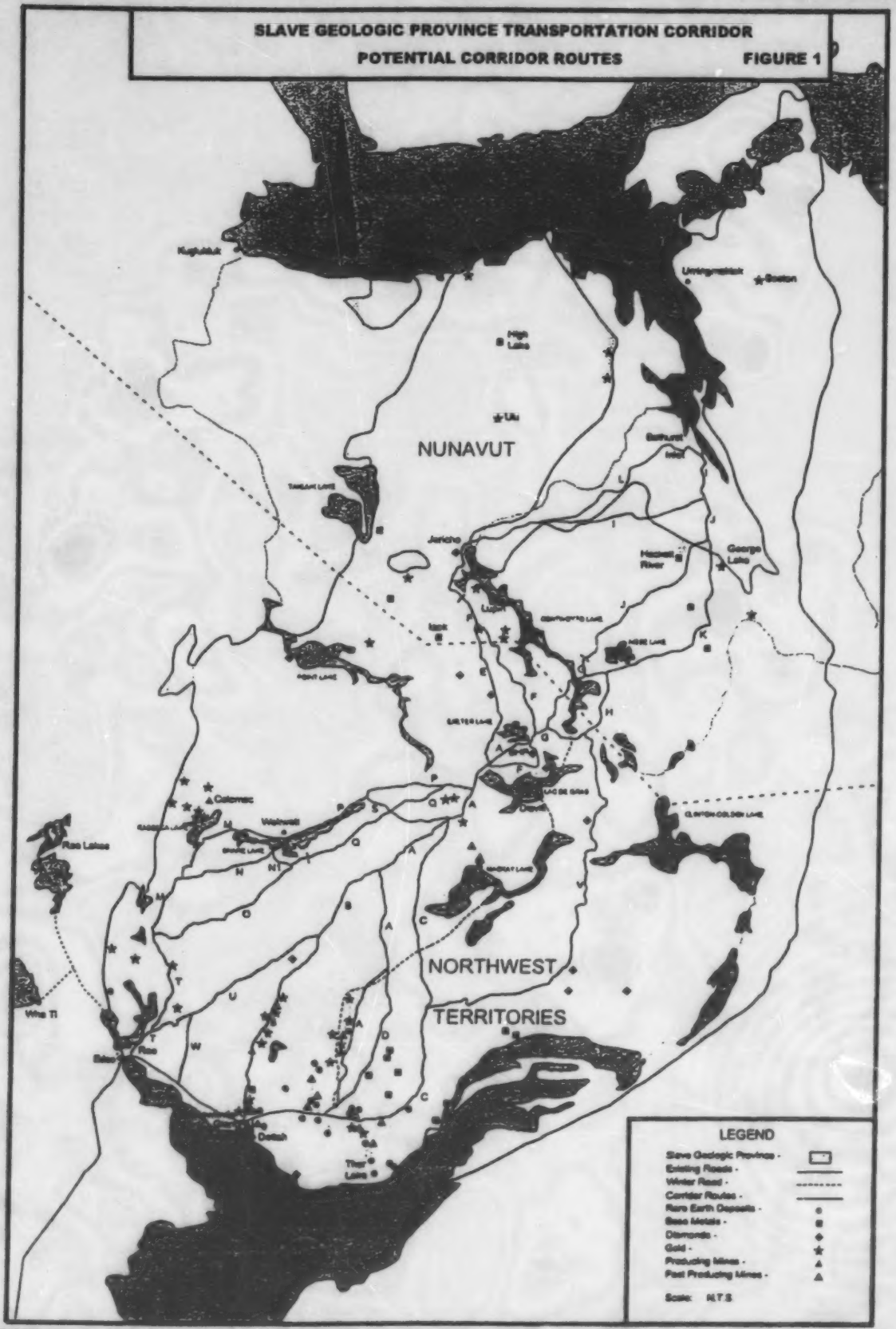
Cost estimates shown in this report were developed using standard engineering principles and standards along with, as much as possible, actual historic unit prices experienced by the Department over the past several years for similar type work. Factored unit prices for embankment construction and surfacing were determined for each route, or segment thereof. These prices were factored to take into account the remoteness of the project, local soil conditions, the quality, quantity and location of natural granular deposits and the absence of public traffic. An assessment on the aggregate potential for each route, or segment thereof, was made and a rating (poor, fair, good) was applied to these unit prices.

Each route was assessed for drainage structure requirements (bridges and culverts) and estimated numbers and unit costs were applied. Costs for engineering, design and contract administration were included to establish an overall estimated cost per kilometre. These estimates are based on standard GNWT contracting policies with estimated individual or annual project budgets in the 25 million dollar range.

The estimated costs shown in this report were prepared to obtain a general idea of what the costs of this roadway would be and are based on the accumulation of selected route segments starting from the north shore of Great Slave Lake to the area northwest of Lac de Gras and then onto Bathurst Inlet. This report does not consider any single definitive starting point, Rae/Edzo verses Yellowknife, nor does it take into consideration any royalty payments or land acquisition costs that may be payable to First Nation groups.

SLAVE GEOLOGIC PROVINCE TRANSPORTATION CORRIDOR

POTENTIAL CORRIDOR ROUTES **FIGURE 1**



STUDY AREA

The Slave Geologic Province, as shown in Figure 1, lies entirely within the Precambrian or Canadian Shield. It runs north / northeast from the north shore of Great Slave Lake to the Bathurst Inlet / Coronation Gulf. It's boundaries are defined by three distinct fault lines;

Bathurst Fault along the east
McDonald Fault along the south
Wopmay Fault along the west

Two major bedrock structural subdivisions occur within the Slave Geologic Province. The archean-age igneous intrusives which occupies approximately 45% of the Slave Geologic Province; lies mainly to the east of Mackay and Contwoyto Lake areas; typified by massive, unusually uniform, granitic intrusions and the Yellowknife Supergroup supracrustal strata which occupies approximately 30% of the Slave Geologic Province; especially prominent in the central portion west of Contwoyto and Lac de Gras, typified by volcanic to metavolcanic intrusives (granites, tonalites and granitoid gneisses).

Some areas are predominately bedrock which are generally overlain with a thin cover of sandy till materials. Eskers and kame complexes (gravel ridges) are scattered throughout (greater north of Lac de Gras). The area is basically a low lying area, rarely exceeding 600 metres above sea level, with a maximum relief that is generally in the 60 to 70 metre range. Lakes and localized ponding are found throughout the study area, along with bogs and marshlands blanketing large areas due to the low relief and resulting slow drainage and the thin surficial deposits overlying the undulating bedrock.

DESIGN PARAMETERS

The design parameters selected for the Slave Geologic Province Transportation Corridor, and the resultant cost estimates (Class D), were for an all-weather roadway with a design speed of 90 kilometres per hour. The design parameters and cross-section are described below and shown in Figure 2.

Design Speed
90 kilometres per hour

Horizontal Alignment

Minimum Radius (m)	300
Min. Stopping Sight Distance (m)	170
Min. Decision Sight Distance (m)	275

Vertical Alignment	
Sag 'K' Value	40
Crest 'K' Value	55
Maximum Gradient (%)	8
Cross Section	
Finished Roadtop Width (m)	10
Granular Base / Surfacing (mm)	250
Subgrade Width (m)	11.5
Min. Embankment Fill Height (m)	1.0
Cross-fall (%)	3
Max. Superelevation (%)	8
Side Slope Ratio	3 to 1

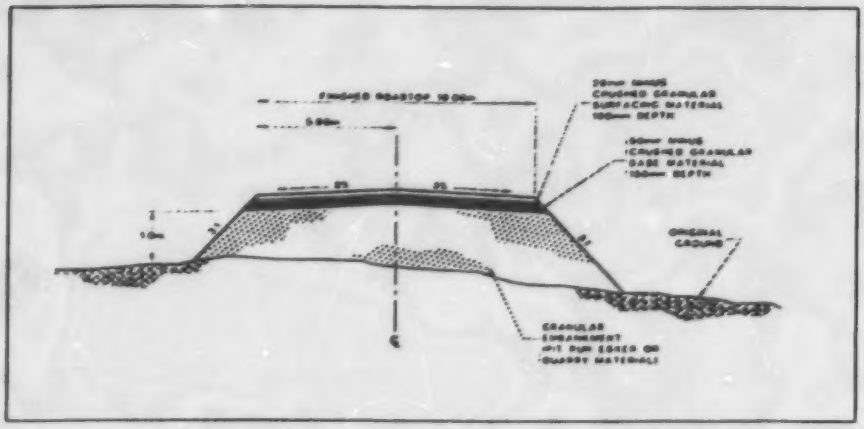


Figure 2 - Typical Design Cross-section

QUALITATIVE RANKING FOR AGGREGATE POTENTIAL

A qualitative ranking of aggregate potential for each route, or segment thereof, was developed from the review of the 1:60,000 black and white aerial photography (Multi-Level Mapping and Route Analysis). The following presents the qualitative description of the ranking system used; no quantitative assessments have been made of any esker/glaciofluvial deposit potential.

Poor

No or very few eskers or glaciofluvial deposits were identified on the aerial photographs; are poorly spaced along the route (eskers are located only at one end of the route).

Fair
Significant number of eskers were identified on the aerial photographs; eskers are somewhat poorly spaced throughout the route; and are comprised mainly of sand.

Good
Significant esker and glaciofluvial deposits in the form of outwash plains were identified on the aerial photographs; deposits are evenly distributed along the route; and are comprised of a combination of sand, gravels, cobbles and boulders.

ESTIMATED ROADWAY QUANTITIES

Although the design parameters identified a minimum embankment height of one (1) metre (structural embankment), quantity estimates were developed using an average embankment height of 1.3 metres. This would allow for the extra fill quantities required to meet the vertical alignment criteria, to level out the original undulating ground profile and to allow for consolidation of the original natural ground cover and natural settlement and consolidation of the constructed road embankment.

Table 1 provides the estimated quantity requirements for each kilometre of embankment construction and surfacing as described above.

Description	Average Height (m)	Average Width (m)	cu. metres per Linear metre	cu. metres per kilometre
Embankment	1.30	12.40	16.20	16,200.00
Surfacing	0.25	10.40	2.40	2,600.00

Table 1 - Estimated Roadway Quantities

ESTIMATED UNIT COSTS

Estimated unit costs were developed using, as much as possible, actual or historic unit prices associated with recent highway construction projects of a similar nature. These prices were than factored to take into account the extra costs that could be expected due to the remoteness of the project, local soil conditions and the qualitative ranking for aggregate potential. Costs were also adjusted to reflect the potential savings expected due to the absence of public traffic and the probability of completing the work on a larger scale with individual projects being somewhere around 25 million dollars each.

Table 2 provides the estimated factored unit costs for embankment construction and surfacing based on the qualitative ranking of the aggregate potential as described above.

Description	Estimated Unit Costs (per cu. M) (based on aggregate potential)		
	Poor	Fair	Good
Embankment Construction	$27.50	$22.00	$18.00
Production/Application of Surfacing	$28.00	$22.00	$20.00

Table 2 - Estimated Unit Costs

AVERAGE COST PER KILOMETRE

Estimated costs per kilometre of embankment construction were derived from the estimated quantities for embankment construction and surfacing, as shown in Table 1, multiplied by the estimated unit costs, as shown in Table 2,

Table 3 provides the estimated average cost per kilometre for embankment construction and surfacing only. These figures do not allow for construction of any drainage/stream crossing structures, nor do they represent any costs associated with preliminary and engineering surveys, roadway design or contract preparation and administration.

Description	Estimated Costs per km (based on aggregate potential)		
	Poor	Fair	Good
Embankment Construction	$445,500.00	$356,400.00	$291,600.00
Production/Application of Surfacing	$72,800.00	$57,200.00	$52,000.00
TOTAL	**$518,300.00**	**$413,600.00**	**$343,600.00**

Table 3 - Estimated Average Embankment Construction Cost Per Kilometre (based on Aggregate Potential)

STREAM CROSSING/DRAINAGE AND ENGINEERING COSTS

Single lane bridges were used in the development of cost estimates for any bridges required within the transportation corridor. An estimate of three culverts would be required for each kilometre of embankment constructed. Engineering, design and

contract preparation and administration costs were derived using historic, in-house costs associated with these types of activities.

Table 4 provides the estimated costs per stream crossing structure or kilometre for drainage structures, engineering, design and contract administration.

Description	Cost per Structure	Cost per Kilometre
Bridges	$1,000,000.00	
Culverts / Drainage Improvements		$18,700.00
Engineering Surveys & Geotechnical		$20,000.00
Design & Contract Preparation		$10,000.00
Contract Supervision & Admin.		$10,000.00

Table 4 - Estimated Stream Crossing/ Drainage and Engineering Costs

THEORETICAL ROUTES
ESTIMATED CONSTRUCTION COSTS

This section provides a summary of the estimated construction costs for each sample or theoretical route of the roadway, through the Slave Geologic Province, from the north shore of the Great Slave Lake to Bathurst Inlet. These routes or segments thereof are shown in Figure 1. Further details of these estimates can be found in the estimate work sheets included in this document under Appendix A.

Table 5 provides the estimated total costs for each sample or theoretical route along with the average total costs per kilometre.

DESCRIPTION	LENGTH (KILOMETRES)	ESTIMATED STRUCTURES	AGGREGATE POTENTIAL	ESTIMATED COSTS PER KILOMETRE	ESTIMATED COSTS FOR ROUTE
Tibbet Lake Bathurst Inlet					
Route A / F / H / G / J / I	715	14	Poor/Fair	$538,006.99	$384,675,000.00
Tibbet Lake to Bathurst Inlet					
Route C / V / H / G1 / G / J / I	825	24	Fair	$498,528.48	$411,286,000.00
Tibbet Lake to Bathurst Inlet					
Route A / F / I / L / I	840	23	Poor/Fair/ Good	$522,276.79	$438,712,500.00
Yellowknife Hwy (km 271) to Bathhurst Inlet					
Route W / U / B / A / F / G / J / I	765	22	Poor/Fair	$551,013.07	$421,525,000.00
Rae Edzo to Bathurst Inlet					
Route T / U / B / A / F / H / G / J / I	780	21	Poor/Fair	$550,230.77	$429,180,000.00
Route T / M / N / P / A / F / H / G / J / I	810	19	Poor/Fair	$524,193.83	$424,597,000.00
Contwoyto Lake (East) to Bathurst Inlet (approximate location of Nuna Route)					
Route J / I	235	5	Fair/Poor	$488,576.60	$114,815,500.00

Table 5 - Estimated Construction Costs

CONCLUSION

The estimates, as provided in this report, indicate that any transportation corridor, as defined earlier in this report, that is to be constructed within the Slave Geologic Province, will cost approximately $ 500,000 to $ 550,000 per kilometre, and the total length of roadway, between the north shore of Great Slave Lake and Bathurst Inlet, could cost in the neighborhood of between $ 380 and $ 440 million dependant on the final route location. These estimates assume that the annual or project level funding will be in the 25 million dollar per year or project area range and do not take into consideration any costs associated with land acquisitions or royalties payable to first nation land claimant groups.

C. Inuvik Tuktoyaktuk Road

C.1 Consultations

An initial Stakeholder Workshop was held in Inuvik on June 9, 1999, and in Tuktoyaktuk on June 10, 1999. The Inuvik workshop was attended by approximately 40 stakeholders. The Tuktoyaktuk workshop, which was held because Tuktoyaktuk residents were weathered out of the workshop in Inuvik, was attended by approximately 15 stakeholders.

Following the workshop a Stakeholder Advisory Committee was set up. This committee consisted of eight individuals from local Aboriginal and community organizations. A list of the committee members is provided below.

- William Nasogaluak, Hamlet of Tuktoyaktuk,
- Russell Newmark, Hamlet of Tuktoyaktuk,
- Mervyn Gruben, Hamlet of Tuktoyaktuk,
- George Roach, Town of Inuvik,
- Vivian Hunter, Town of Inuvik,
- Derek Lindsay, Town of Inuvik,
- Gerry Kisoun, Inuvialuit Corporate Group, and
- Gwich'in Tribal Council.

This committee met on September 3, 1999, to discuss the studies proposed by the Department, and has since been kept informed of the status of the studies. A second meeting of this committee was held on March 18, 1999, in Inuvik to update the status of the studies.

Formal public consultations were undertaken as part of the Environmental Scoping Study. The environmental consultants and Department representatives traveled to each of the affected communities for public meetings to discuss socio-economic and environmental issues. A list of the communities and dates of consultations is provided below.

- Inuvik – January 18, 1999
- Aklavik – January 19, 1999
- Tsiigehtchic – January 21, 1999
- Fort McPherson – January 20, 1999
- Tuktoyaktuk – January 25, 1999

Key stakeholder consultations were also undertaken as part of the Land Issues, Benefit Cost Analysis and Financing studies. These were held both in-person and by telephone.

C.2 Studies Undertaken

Summaries of the following four studies undertaken by the Department on the Inuvik Tuktoyaktuk Road are attached.

- Environmental Scoping Study
- Pre-Engineering Study
- Benefit Cost and Economic Impact Analysis
- Financing Study
- Land Issues Study

C.3 Executive Summary of the Environmental Scoping Study Inuvik Tuktoyaktuk Road

Department of Transportation
Transportation Planning Division

PROPOSED INUVIK-TUKTOYAKTUK ROAD

ENVIRONMENTAL/SOCIOECONOMIC BASELINE REPORT

Prepared for:

Department of Transportation
Government of the Northwest Territories
Yellowknife, Northwest Territories

Prepared by:

Rescan Environmental Services Ltd.
Yellowknife, Northwest Territories

May 1999

EXECUTIVE SUMMARY

Background

The Department of Transportation (DOT), Government of the NWT (GNWT) is preparing a Highway Strategy which encompasses four road proposals in the NWT. One of the road proposals under consideration is an all weather road between Inuvik and Tuktoyaktuk.

The existing transportation infrastructure in Inuvik and Tuktoyaktuk consists of: a seasonal ice road between Inuvik and Tuktoyaktuk, which is in operation approximately 3 months each year; year round scheduled and charter air access into each community; and all weather road access to Inuvik via the Dempster Highway #8, with ferry crossings/ice bridges on the Mackenzie River at Fort McPherson and on the Arctic Red River at Tsiigehtchic.

The idea of improving the transportation infrastructure in this area has been on-going since the late 60s. The first route survey took place in 1974 when oil and gas activity was occurring in this area. A 140 km land route was identified in 1977. This route is known as the 1977 Public Works Canada alignment. Preliminary engineering and environmental studies were undertaken on this route in 1975 and 1976. In general, this is still the preferred route for the residents of the area.

To provide a long term plan for the development of transportation infrastructure in the NWT, DOT developed the Northwest Territories Transportation Strategy in 1990. The Strategy was updated in 1994. A road corridor from Wrigley to Tuktoyaktuk, which includes the Inuvik to Tuktoyaktuk section, was identified as infrastructure which would be needed to support resource and other economic development activities in the region.

In March 1998, the GNWT announced its new roads initiative and dedicated funds for the socio-economic, environmental, regulatory, engineering, benefit/cost and economic impact investigations of four road proposals, including the Inuvik to Tuktoyaktuk road.

The proposed road would be considered an all-weather road, with two construction standards under consideration: the first option is based on a design speed of 80 km/hr, and the second is designed for 60 km/hr. The allowable gradient, stopping sight distance and fill required are the parameters that vary with design speed.

Environmental Scoping of the Road Proposal

Rescan™ Environmental Services Ltd., in association with Terriplan Consultants Ltd., Dillon Consulting, Arc Wildlife Services, Points West Heritage Consulting Ltd., and Aimm North Heritage Consulting, were retained by DOT to conduct an environmental scoping study for the road proposal. The results of the scoping study would be used to assist in preparing an environmental assessment of the potential project.

The purpose of the scoping study was the identification of the biophysical, social, economic and cultural issues and concerns of project stakeholders regarding the potential development. In addition, the consultants were required to identify the likely regulatory review process that would be launched should the road be constructed.

Stakeholder Concerns

Project stakeholders, including residents, elders, government, aboriginal organizations, land owners and regulators were consulted. Community consultations and discussions for traditional knowledge acquisition were held in January, 1999 in the communities of Fort McPherson, Tsiigehtchic, Aklavik, Tuktoyaktuk and Inuvik. Interviews with the remaining stakeholders took place throughout the project.

Overwhelming support was expressed by community residents during the consultation sessions, however, some concerns with the potential project were identified.

The major issues resulting from these sessions can be categorized as follows:

- potential social costs and benefits;
- potential economic costs and opportunities;

- project and routing issues;
- land claims and regulatory issues; and
- effects of the project on fish, wildlife, habitat and traditional land uses.

Table I at the end of the Executive Summary summarizes the issues raised during the consultations and identifies where further information on each topic can be found in the body of the report.

Regulatory Process

An important consideration in the planning for the development of a road between Inuvik and Tuktoyaktuk includes an examination of the regulatory requirements which must be satisfied to achieve project approval.

The permits, licences and authorizations required for the construction and operation of the road have been identified. Two possibilities for regulatory review exist: one possibility would be followed if the road were constructed entirely within the Inuvialuit Settlement Region (ISR), and the other would be followed if the road were constructed in both the Gwich'in Settlement Region and the ISR.

The regulatory review process would be simplified if the entire road corridor was located within the physical boundaries of the Inuvialuit Settlement Region. This can be achieved by starting the proposed new road at the present terminus of the existing Old Navy Road. Although there would be transboundary implications which must be considered, the paramount environmental impact assessment process to be satisfied would be that embodied in the Inuvialuit Final Agreement (IFA).

In the event that the final road alignment was located on both Gwich'in Settlement Area and Inuvialuit Settlement Region lands, the project would likely be determined to be a Transboundary Project and would need to satisfy the review process requirements of both the IFA and the Mackenzie Valley Resource Management Act (MVRMA). It was recommended that the two regulatory review agencies enter into an agreement to coordinate the review process. The details of the process to be followed would need to be defined, but in general are expected to

involve both joint screening, followed by more detailed review of the project by a joint review panel established under the authorities of the IFA and the MVRMA.

Data Gaps

The scoping project involved the identification of information sources related to the development of an all weather road between Inuvik and Tuktoyaktuk. Available documentation was reviewed and summarized in this report. In general, sufficient background information exists for most subject areas. However, data gaps exist for some aquatic resources, vegetation information, wildlife and habitat information related to local resource harvesting, caribou habitat use, grizzly bear use of the area, denning areas and raptor sites.

Should the project proceed and require an environmental review, field work would likely be required to address the lack of information for these subject areas.

Table I
Summary Issues Table

Issue	Where Issue Raised	Party	Where Issue Addressed in Report
<u>Potential Social Costs and Benefits</u>			
A land road is safer than the ice road	Fort McPherson Inuvik Tuktoyaktuk	TK CC CC, TK	7.3.3 6.3.1, 7.3.2 6.3.5, 7.3.5
Ice road is dangerous and has killed people	Aklavik	TK	7.3.2
The ice road is dangerous and can cause seasonal depression when it closes	Tuktoyaktuk	CC, TK	4.3.5, 6.3.5, 7.3.5
Aklavik has concern about the ice road if Tuk no longer needs it	Aklavik	CC	6.3.2
Road needs to be of a standard to prevent accidents	Inuvik	TK	2.3, 7.3.1
Road will improve year-round access and commerce between Aklavik and Tuk	Aklavik Inuvik	CC, TK CC, TK	2.1, 6.3.2, 7.3.2 2.1, 6.3.1, 7.3.1
The road will facilitate year-round access between Tuk and Fort McPherson	Fort McPherson	CC, TK	2.1, 6.3.3, 7.3.3
Road will improve year-round access for public, businesses, medical services, *etc.*	Tsiigehtchic	TK	2.1, 7.3.4
Road will improve year-round access, commerce and will reduce costs of goods and services in Tuk	Tuktoyaktuk	CC, TK, SC	4.4, 6.3.5, 7.3.5
Commercial construction is preferred over community building program	Aklavik	CC	6.3.2
Increased road access may cause an increase in crime at cabins	Aklavik Tuktoyaktuk	TK TK	7.3.2 7.3.5
Road may have negative effects on youth, culture, alcohol and drugs and the community	Tuktoyaktuk	CC, TK	6.3.5, 7.3.5
Social problems already exists (alcohol and drugs) and may increase as a result of the road	Tsiigehtchic	TK	4.4, 7.3.4
Road may increase intermarriages between Gwich'in and Inuvialuit	Tsiigehtchic	CC, TK	4.4, 6.3.4, 7.3.4
Good project, should have been done long ago	Fort McPherson	TK	7.3.3

(continued)

Table I
Summary Issues Table (Continued)

Issue	Where Issue Raised	Party	Where Issue Addressed in Report
<u>Potential Economic Costs and Opportunities</u>			
Good project which will benefit the region	Inuvik	CC	6.3.1, 7.3.1
Money is wasted on ice road	Aklavik	TK	7.3.2
Selected route is shortest and least costly	Tuktoyaktuk	CC, SC	2.2, 6.3.5
Commercial construction is preferred over community building program	Aklavik	CC	6.3.2
How much in royalties would be paid to the Inuvialuit for gravel and who would pay	Aklavik	CC, TK	6.3.2, 7.3.2
Project will provide training and jobs and contribute to a new way of life	Inuvik	TK	4.4, 7.3.1
	Aklavik	TK	4.4, 7.3.2
	Fort McPherson	CC, TK	4.4, 6.3.3, 7.3.3
	Tsiigehtchic	TK	4.4, 7.3.4
	Tuktoyaktuk	CC	4.3.5, 4.4, 6.3.5
Road will reduce costs of groceries to Tuk and will facilitate access to medical services in Inuvik	Inuvik	TK	4.4, 7.3.1
Community members and construction contractors should both benefit from project	Tuktoyaktuk	CC, TK, SC	6.3.5, 7.3.5
People need training *e.g.* heavy equipment operators to participate effectively	Tuktoyaktuk	CC	4.4, 6.3.5
Will draw more tourists to the region (*e.g.* Art Festival, hovercraft project, *etc.*)	Inuvik	CC	6.3.1
Tourists can drive to the Arctic Ocean and will increase tourism in Fort McPherson	Fort McPherson	CC, TK	2.1, 6.3.3, 7.3.3
Road will generate employment opportunities for Gwich"n and Inuvialuit	Tssigehtchic	CC, TK	6.3.4, 7.3.4
Will draw more tourists to the region (to see Tuk and the ocean)	Fort McPherson	TK	7.3.3
Would provide recreational/touring opportunities	Inuvik	CC	6.3.1
Local people should be trained and employed to patrol and monitor the road	Aklavik	CC	6.3.2
Concern about who will pay for the road	Inuvik	CC, TK	6.3.1, 7.3.1
IRC should help fund the road	Tuktoyaktuk	TK	7.3.5
Road should be built now, funding sources need to be determined	Tuktoyaktuk	CC, TK, SC	6.3.5, 7.3.5
Funding sources and a lead agency are needed to move this project forward	Tuktoyaktuk	CC, SC	6.3.5
Seasonal road access is fine. The year-round road would negatively impact the air transportation industry	Tuktoyaktuk	CC	6.3.5

(continued)

Table I
Summary Issues Table (Continued)

Issue	Where Issue Raised	Party	Where Issue Addressed in Report
Project and Routing Issues			
Good choice of routing	Tsiigehtchic	CC, TK	6.3.4, 7.3.4
Preference for using old Navy Road as kick-off point	Aklavik Tuktoyaktuk	TK TK	2.2, 7.3.2 2.2, 7.3.5
Close to existing snowmobile trails	Inuvik	CC	6.3.1
Keep route away from Noell Lake to protect cabin owners and fisheries	Inuvik	CC	3.4.5, 6.3.1
Highest ground, most gravel and most level ground located along proposed corridor	Tuktoyaktuk	CC, TK	3.2.3, 3.2.4, 6.3.5, 7.3.5
High ground, most level ground, and gravel on the Tuk Peninsula located along Husky Lakes	Tuktoyaktuk	CC	3.2.3, 3.2.4, 6.3.5
Interior power line route more hummocky with steep slopes, more water and permafrost	Tuktoyaktuk	CC, TK	3.2.2, 3.2.4, 6.3.5, 7.3.5
Some preferred that the route follow the powerline north of Parsons lake	Tuktoyaktuk	CC, TK	
Three critical areas identified where the road should be realigned at least 2.5 km from the shore to protect local interests	Tuktoyaktuk	CC	3.4.5, 6.3.5
The road provides good access to Husky Lakes area but avoid locating the road too close to the lakeshore	Fort McPherson	CC, TK	3.4.5, 6.3.3, 7.3.3
Construction camps should be a certain distance from the highway and preplanned	Fort McPherson	CC	6.3.3
Some preferred the route follow the Mackenzie River	Tuktoyaktuk	CC, TK	6.3.5, 7.3.5
Impacts Benefits Agreements (IBA) will be needed	Yellowknife	DIAND	8.4.6
Gwich'in want to be involved in road construction and maintenance	Fort McPherson	CC, TK	6.3.3, 7.3.3

(continued)

Table I
Summary Issues Table (Continued)

Issue	Where Issue Raised	Party	Where Issue Addressed in Report
Land Claims and Regulatory Issues			
IFA Section 8(1) outlines special considerations which must be satisfied for the Husky Lakes area	Inuvik	CC, JS	3.4.5, 6.3.1, 8.4.7
Frequent regulatory monitoring should be conducted to protect the resources in the Husky Lakes area	Tsiigehtchic	CC, TK	3.4.5, 6.3.4, 7.3.4
Tourist use of the road and natural resources, especially around Husky Lakes needs to be carefully controlled	Tuktoyaktuk	CC, TK, ILA	6.3.5, 7.3.5, 8.4.8
Husky Lakes issues must be reviewed by the EIRB	Tuktoyaktuk, Inuvik, Yellowknife	ILA, JS, DIAND, EC, GNWT	8.4.7, 8.4.8
Project will require screening and review by ILA, EISC, EIRB, GLWB and other stakeholders	Inuvik	JS, GLWB	8.4.7, 8.4.9
Inuvialuit Game Council should play an important role in providing people to monitor and patrol the road	Fort McPherson	CC	6.3.3
Inuvialuit regulatory agencies should ensure the project is properly regulated especially around Husky Lakes, pingos and other critical areas	Tuktoyaktuk	ILA	6.3.5, 8.4.8
Inuvialuit would have to work with RWED and other regulators to ensure protection	Tuktoyaktuk	CC	6.3.5
An agreement should be developed between the Inuvialuit and the Gwich'in for hunting quotas, protection measures, etc.	Tsiigehtchic	CC	6.3.4
If the project has transboundary implications the MVEIRB will become more involved in reviewing the project. An agreement will be required	Yellowknife	MVEIRB, MVLWB	8.4.1, 8.4.2
Review of alternatives will be required	Yellowknife	MVEIRB	8.4.1
Socioeconomic issues require equal assessment with environmental issues	Yellowknife	MVEIRB	8.4.1
Cumulative effects and possible impacts beyond the ISR would need to be assessed.	Yellowknife Yellowknife Inuvik	MVEIRB EC JS	8.4.1 8.4.3 8.4.7
Sources of aggregate and associated infrastructure would need to be considered	Yellowknife	EC	8.4.3
Regulators and aboriginal organizations should work together to establish zoning/restrictions/enforcement issues	Fort McPherson	CC	6.3.3
DFO and the Inuvialuit co-manage fisheries within the ISR	Yellowknife	DFO	8.4.5

(continued)

Table I
Summary Issues Table (Continued)

Issue	Where Issue Raised	Party	Where Issue Addressed in Report
Land Claims and Regulatory Issues (Continued)			
Impacts Benefits Agreements (IBA) will be needed	Yellowknife	DIAND	8.4.6
DIAND Minister will receive and approve joint panel reports and will authorize or license approvals under its jurisdiction	Yellowknife	DIAND	8.4.6
Authorizations to destroy or alter fisheries habitat will be regulated under Section 35(2) of the Fisheries Act	Yellowknife	DFO	8.4.5
RWED would encourage one project-one process approach	Yellowknife	RWED	8.4.4
Road will enhance hunting opportunities which must be managed	Tsiigehtchic	CC, TK	3.6.1, 6.3.4, 7.3.4
Hunting by Gwich'in and Inuvialuit on each other's land will increase and must be managed	Tsiigehtchic	TK	7.3.4
Hunting off the road should be carefully regulated and monitored	Fort McPherson	TK	3.6.1, 7.3.3
Hunting, fishing and trapping must be managed	Inuvik	CC, TK	6.3.1, 7.3.1
Hunting along the road must be more carefully regulated than on the Dempster	Fort McPherson	CC	3.6.1, 6.3.3
Strict environmental rules and enforcement will be required	Inuvik	TK	7.3.1
Signage outlining offenses and fines should be posted along road, especially in sensitive areas	Fort McPherson	CC	6.3.3
Regulations and enforcement needed for tourists	Tsiigehtchic	TK	7.3.4
People should be educated on measures to protect the environment	Fort McPherson	CC, TK	6.3.3, 7.3.3
Apply lessons learned from the Dempster Highway to protect natural resources	Aklavik	CC	3.6.1, 6.3.2
Tourists will need to follow regulations including HTO Requirements	Aklavik	TK	7.3.2
Tourists need to be monitored and regulations need to be developed and enforced	Tsiigehtchic	TK	7.3.4
Littering and pollution issues must be managed	Inuvik Tuktoyaktuk	TK CC, TK	7.3.1 7.3.5
Mammoth tusks and fossils are found along the proposed route	Inuvik	TK	7.3.1
Land exchanges with the Inuvialuit may be needed as it will be a public road	Tuktoyaktuk	CC, SC	6.3.5

(continued)

Table I
Summary Issues Table (Continued)

Issue	Where Issue Raised	Party	Where Issue Addressed in Report
<u>Effects of Project on Fish, Wildlife, Habitat and Traditional Land Uses</u>			
Tourist use of the road and natural resources, especially around Husky Lakes needs to be carefully controlled	Tuktoyaktuk	CC, TK, ILA	6.3.5, 7.3.5, 8.4.8
The natural resources of the Husky Lakes area must be protected	Tuktoyaktuk	CC, TK, ILA	6.3.5, 7.3.5, 8.4.8
Caribou need to be protected	Tuktoyaktuk	CC, TK	3.6.1, 3.6.2, 6.3.5, 7.3.5
Hunting along the road must be more carefully regulated than on the Dempster	Fort McPherson	CC	3.6.1, 6.3.3
Road will enhance hunting opportunities which must be managed	Tsiigehtchic	CC, TK	3.6.1, 6.3.4, 7.3.4
Hunting off the road should be carefully regulated and monitored	Fort McPherson	TK	3.6.1, 7.3.3
Hunting, fishing and trapping must be managed	Inuvik	CC, TK	6.3.1, 7.3.1
Apply lessons learned from the Dempster Highway to protect natural resources	Aklavik	CC	3.6.1, 6.3.2
Caribou unlikely to be affected except by increased hunting	Aklavik	CC, TK	3.6.1, 6.3.2, 7.3.2
Caribou, moose and other wildlife unlikely to be affected by the road, based on experience with Dempster	Inuvik Fort McPherson Tsiigehtchic	CC, TK CC, TK CC, TK	3.6.1, 6.3.1, 7.3.1 3.6.1, 6.3.3, 7.3.3 3.6.1, 6.3.4, 7.3.4
Reindeer herd management issues can be managed	Inuvik	CC, TK	3.6.2, 7.3.1
Employ suitable designs for stream crossings to protect fish, rats and beavers	Fort McPherson	TK	3.3.1, 7.3.3
Road will place increased harvesting pressure on fish lakes which must be managed	Aklavik	TK	7.3.2
Road will increase harvesting access to fish, lakes and may impact fish at stream crossings	Tsiigehtchic Tuktoyaktuk	TK CC, TK	3.4.6, 7.3.4 3.4.6, 6.3.5, 7.3.5
Impacts on hunting and fishing camps need to be considered	Inuvik	TK	3.4.6, 3.6.1, 7.3.1
Road will improve access to berries	Aklavik Inuvik Tsiigehtchic Inuvik	TK TK CC, TK TK	7.3.2 3.6.1, 7.3.1 3.5.2, 6.3.4, 7.3.4 7.3.1

(continued)

Table I
Summary Issues Table (Continued)

Issue	Where Issue Raised	Party	Where Issue Addressed in Report
Effects of Project on Fish, Wildlife, Habitat and Traditional Land Uses (Continued)			
Use of calcium on roads may be harmful to vegetation and ptarmigan	Fort McPherson	TK	7.3.3
Littering and pollution issues must be managed	Inuvik	TK	7.3.1
	Tsiigehtchic	TK	7.3.4
Owners of cabins near proposed road alignment need to be consulted	Tuktoyaktuk	TK	7.3.5
Some historic sites (habitation and graves) in the area (although not near the route). These should be protected	Tuktoyaktuk	TK	5.2, 7.3.5
Other Issues			
What other routes are being studied? Deviations from the preferred route may delay decisions	Tuktoyaktuk	CC, SC	6.3.5
An oral history program to educate public would be useful	Tuktoyaktuk	TK	7.3.5
Should be a road from the Dempster to Aklavik	Fort McPherson	TK	7.3.3
Community survey reported 267 people in favor, 29 opposed to year-round road	Tuktoyaktuk	CC	4.3.5, 4.4, 6.3.5
Will the route be finalized by March 31	Tuktoyaktuk	CC	6.3.5

CC: Community Consultation participant
DIAND: Department of Indian and Northern Affairs
EC: Environment Canada
GLWB: Gwich'in Land and Water Board
ILA: Inuvialuit Land Administration
JS: Joint Secretariat
MVLWB: Mackenzie Valley Land and Water Board
RWED: Resources Wildlife and Economic Development
SC: Inuvik-Tuktoyaktuk highway Stakeholder Committee
TK: Traditional Knowledge elder interviewee

f2

C.4 Summary of the Pre-Engineering Study Inuvik Tuktoyaktuk Road

INUVIK TO TUKTOYAKTUK ROAD

(PRE-ENGINEERING UPDATE)

Prepared by:
Highways and Engineering Division
Department of Transportation

MARCH 1999

TABLE of CONTENTS

		Page
1.	Introduction	1
2.	Level of Service	1
3.	Route Alignment	1
4.	Previous Work by Public Works Canada	3
5.	Design Standards	3
6.	Cost Estimates	4
7.	Project Scheduling	5
8.	Project Implementation	6
9.	Further Engineering Work	6
FIGURE 1	PWC'77 Alignment	2
FIGURE 2	TYPICAL DESIGN CROSS SECTION	4
TABLE 1.	Design Parameters and Preliminary Cross Section	3
TABLE 2.	Construction Cost Estimates	5

1. INTRODUCTION

This report presents a discussion of some of the engineering components and updated cost estimates to construct a road between Inuvik and Tuktoyaktuk, NT. This report is one of several studies undertaken by the Department of Transportation for the Inuvik to Tuktoyaktuk Road to aid in developing a comprehensive package for further planning and decision making. Environmental Scoping and a Benefit/Cost Analysis are other studies which were undertaken as part of the package.

This report specifically addresses the level of service, route alignment and design standards which were used to develop the cost estimates.

2. LEVEL OF SERVICE

Through consultation with the Inuvik to Tuktoyaktuk Highway Stakeholder Advisory Committee, it was determined that any road link between Inuvik and Tuktoyaktuk should be constructed to an all-weather standard. That is, it should be capable of providing dependable, year round use by passenger vehicles, recreational vehicles and transport trucks with appropriate seasonal weight restrictions. A 'fair weather' road, which would not be capable of handling truck traffic and could be closed for some periods of the summer due to weather or road conditions, would not provide the envisioned benefits of reduced resupply costs, increased tourist traffic and economic opportunities.

It was decided that this study should look at a low standard, all-weather road with a design speed of 60 kilometres per hour and a similar higher standard, all-weather road with a design speed of 80 kilometres per hour.

3. ROUTE ALIGNMENT

The Stakeholder Advisory Committee favoured the route alignment known as PWC'77 shown on Figure 1 as the one that should be considered for construction of an all-weather road. In 1985, the Inuvialuit Land Administration was opposed to this route because of its close proximity to the Husky Lakes and had suggested a longer route which involved a major shift of the alignment to the west, towards Reindeer Station and along the East Channel. At the present time however, there does not appear to be any opposition to the preferred alignment (PWC'77).

The Department agrees that the PWC'77 alignment is the most logical route for a link between Inuvik and Tuktoyaktuk. Any other route would be longer and more costly to construct.

The PWC'77 route is approximately 140 kilometres long and as discussed in the following section, has been thoroughly studied by Public Works Canada. The route is fairly direct between the communities with the exception of the northern portion which veers to the east and follows the coastal plain of the Husky Lakes. This was done to avoid the rolling topography along a more direct route and to maximize the economical use of identified borrow sources.

BEAUFORT SEA &
KUGMALLIT BAY
POTENTIAL BORROW SOURCE
Km 122
Km 100
PARSON'S CREEK
Km 80
HUSKY LAKE
HANS CREEK
Km 60
ALTERNATE
ALIGNMENT
Km 40
PROPOSED
ALIGNMENT
(PWC '77)
MACKENZIE
Km 20
INUVIK TO TUKTOYAKTUK HIGHWAY
PWC '77 ALIGNMENT
DATE: MARCH 1999
DND SITE
Km 2
INUVIK
DEMPSTER
HIGHWAY
CAMPBELL LAKE

The alternate alignment, shown on Figure 1, would utilize 5 kilometres of existing roadway from Inuvik to the Department of National Defence (DND) Receiver site. However, DND held a 3.2 kilometre radius protective reserve around this site and were reluctant to consider a road through the reserve at the time (mid 70's to early 80's). DND's activities in the Inuvik area have since declined and the alternate alignment should be investigated in more detail.

4. PREVIOUS WORK BY PUBLIC WORKS CANADA

The list of Studies and Reports in Appendix A summarizes the work completed by Public Works Canada on the Inuvik to Tuktoyaktuk Road.

In general, detailed horizontal and topographic surveys were completed for the selected alignment shown on Figure 1 and extensive geotechnical investigations were carried out along the alignment and at potential borrow sources. Work was started on a detailed road design, but only ten (10) kilometres of preliminary design at the Inuvik end was completed before the project was put on hold.

5. DESIGN STANDARDS

As discussed previously, design standards were developed for two types of all-weather road; a 60 kilometres per hour design and a 80 kilometre per hour design. The design parameters and preliminary cross sections that were selected for the two road designs are shown in Table 1.

TABLE 1
DESIGN PARAMETERS AND PRELIMINARY CROSS SECTION

Design Standard	60Km/hr	80Km/hr
Horizontal Alignment		
Min. Radius (m)	120	230
Min. Stopping Sight Distance (m)	85	140
Vertical Alignment		
Sag 'K' Value	20	30
Crest 'K' Value	15	35
Maximum Gradient (%)	10	8
Cross Section		
Roadtop Width (m)	8.4	8.4
Granular Base Course/Surfacing(mm)	100	200
Subgrade Width (m)	9.0	9.6
Minimum Embankment Fill (m)	1.2	1.2
Side Slope Ratio	3 to 1	3 to 1

It should be noted that the minimum embankment fill of 1.2 metres in Table 1 for both road designs is less than the design thickness originally considered by Public Works Canada for previous estimates and is considered to be the minimum that can be used without incurring substantially higher operation and maintenance costs in the future. It was felt that, when the road traverses over the granular borrow areas, the minimum embankment height of 1.2 metres would provide sufficient structural strength to carry the anticipated traffic loading. Increased embankment heights would be constructed through the fill areas and would most likely fall within the 1.5 to 1.8 metre range.

The typical embankment cross section is illustrated in Figure 2.

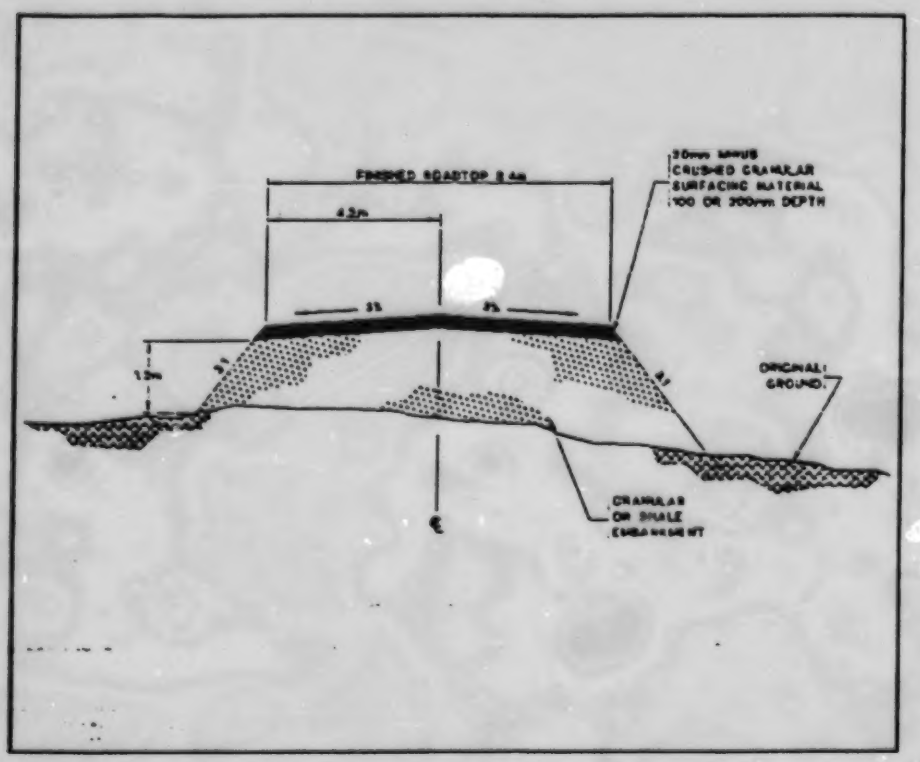


Figure 2.

TYPICAL CROSS-SECTION INUVIK TO TUKTOYAKTUK ROAD

6. COST ESTIMATES

The current cost estimate (1998 dollars) for each of the two standards of road is 100 million dollars for the 60 kilometres per hour design and 135 million dollars for the 80 kilometres per hour design. The cost estimates are based on preliminary quantity estimates developed from the Table 1 design standards and probable construction costs for a project in this area over a ten (10) year construction period. A simplified breakdown of the cost estimates for the two designs is given in Table 2.

TABLE 2
CONSTRUCTION COST ESTIMATES

Description	Estimated Costs 60km/hr	80km/hr
1. Embankment Construction	$83,000,000	$110,000,000
2. Base Construction/Surfacing	$6,000,000	$11,000,000
3. Drainage/Drainage Structures	$1,000,000	$1,000,000
4. Major Structure/Bridges	$1,000,000	$1,000,000
5. Engineering/Supervision	$9,000,000	$12,000,000
TOTAL	**$100,000,000**	**$135,000,000**

The above costs calculate to approximately $715,000 per kilometre and $965,000 per kilometre for the 60 kilometre per hour road and the 80 kilometre per hour road respectively. These per kilometre costs are very similar to the costs reported by the Department in a brief report in 1989. At that time, the updated Public Works Canada estimates for the PWC'77 alignment were $715,000 per kilometre for the 60 kilometre per hour road and $1,050,000 per kilometre for the 80 kilometres per hour road. As mentioned previously, the current designs have a somewhat reduced minimum embankment fill thickness. This would account for the apparent lack of any change in construction costs over the intervening nine (9) year period.

The current cost estimates do not include any royalties or land acquisition costs that may be payable to the Inuvialuit. As nearly two thirds of the alignment is on Inuvialuit Lands, the royalty costs for borrow material (if payable) could be in the order of $5,000,000.00 dollars or averaging two (2) dollars per cubic metre of borrow material (general embankment fill and base granular materials). Even though these costs are a Federal responsibility, they still add to the overall project cost.

Annual operation and maintenance costs for a completed Inuvik to Tuktoyaktuk Road are expected to be in the order of 1.5 to 2.0 million dollars or between $11,000 and $15,000 per kilometre. However, costs may exceed the upper amount in the first four or five years due to more frequent surface repair requirements as any frozen material placed into the embankment thaws in the early years and the embankment distorts and settles. For comparison purposes, the annual maintenance costs for some sections of the Dempster Highway are currently averaging $13,000 per kilometre.

7. PROJECT SCHEDULING

It is anticipated that this project could be constructed most efficiently in any time frame ranging from four years to ten years. A construction period longer than ten (10) years would mean too many of the identified material sources would have to be redeveloped year after year. This could lead to extra effort required for pit drainage and loss of valuable material.

Ideally, all required embankment borrow should be excavated from each material source in one construction season. This is not to say that the project could not be scheduled over a longer period (say 20 years), only that efficiencies are reduced with a longer construction schedule.

8. PROJECT IMPLEMENTATION

A project of this magnitude could be implemented by a series of conventional publicly tendered contracts or by the design-build approach recently used by the Department of Transportation on Yellowknife Highway (No.3). The Department has demonstrated that local employment and training can be maximized by either approach.

A discussion on a community construction approach to the project is included as Appendix B. Under this approach, the emphasis would be entirely on local employment and training through a low level of annual funding and not on completing the road within a reasonable time frame.

9. FURTHER ENGINEERING WORK

The previous work by Public Works Canada has established a good surveyed alignment and substantial geotechnical information on potential borrow sources. However, this data would have to be developed into a detailed design prior to any construction. Most of this would be office based work involving conversion of original survey data from imperial to metric and inputting the corrected data into a computer and preparing the detailed designs.

Since the time of the original alignment surveys in the Tuktoyaktuk area (1975 - 77), some improvements or additions may have been made to the community road system. This will require an assessment to determine if the Inuvik to Tuktoyaktuk Road should or could be realigned, within the community areas, to take advantage of any community road infrastructure investments already in place that would shorten the overall road length. Although this work can be completed just prior to construction activities in the area, it would be best to determine any realignments as early as possible into the project. Costs associated with this assessment work would be minimal, however, if additional preliminary engineering or surveys are required, these costs would be in the twenty to fifty thousand dollar ($20,000 to $50,000) range.

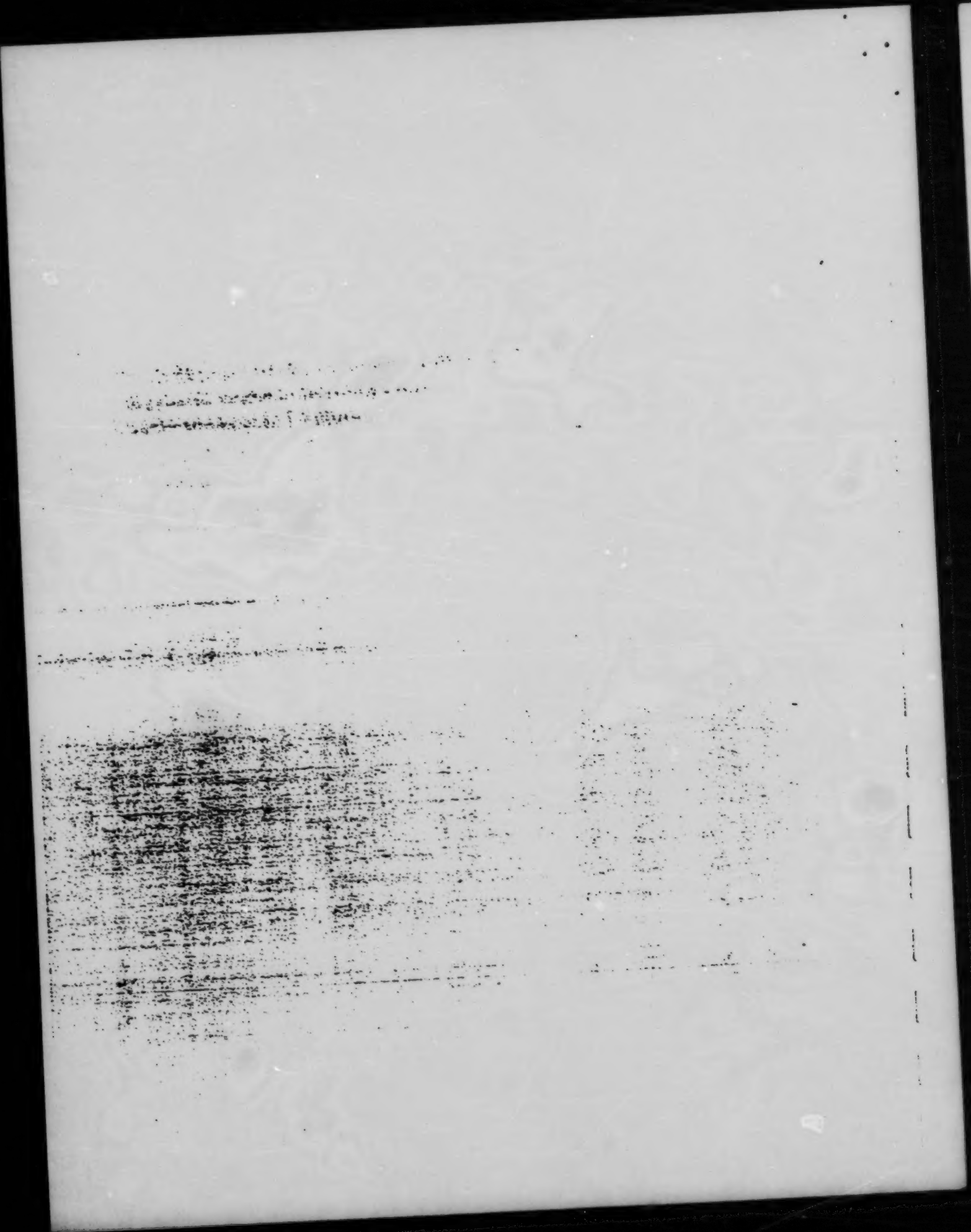
Additional geotechnical drilling and survey field work would be required to assess the alternate alignment shown on Figure 1 which leaves Inuvik from the DND site. This alternate alignment would shorten the construction length by 5 kilometres. However, if borrow sources can not be located near the alignment, it may not be economical. The cost of the field work would be in the order of two hundred fifty thousand dollars ($250,000).

Further geotechnical drilling would also be required at most of the borrow sources in order to delineate the most favourable areas for development. However, much of this work could be done as construction progresses.

Individual contract or design packages and an implementation plan would need to be developed, but these can not be done until a level of project funding is established.

If a decision was made to proceed with the project, all of the pre-engineering surveys, geotechnical investigations, data input, design and contract preparation work required prior to commencing construction, could be completed within a one year period. This is well within the time frame it is expected to take to obtain project approvals and resolve land ownership issues.

C.5 Executive Summary of the Benefit Cost and Economic Impact Analysis Inuvik Tuktoyaktuk Road



FINAL REPORT

BENEFIT-COST AND REGIONAL ECONOMIC IMPACT ANALYSIS: INUVIK TO TUKTOYAKTUK ROAD

Submitted to

Government of the Northwest Territories
Department of Transportation

by

Nichols Applied Management
Management and Economic Consultants
Edmonton Calgary

March, 1999

EXECUTIVE SUMMARY

This report discusses the findings of an economic evaluation and regional economic impact analysis of the construction and operation of the Inuvik to Tuktoyaktuk road. It is part of a number of studies undertaken by the Department of Transportation during the fiscal year 1998/99 as part of the Highway Strategy Initiative.

Study Methodology

The study, undertaken by Nichols Applied Management, relies on the following sources for inputs:

- key respondent interviews and a review of Department of Transportation files to identify the benefits and costs of the proposed project; and
- an analysis by the Department of Transportation of the estimated project costs.

It uses two related but distinct analyses to assess the project. They are:

- a benefit-cost analysis, which determines the economic viability of the project from the perspective of the territorial economy; and
- a regional economic impact analysis, which focuses on the economic benefits to the region.

The study's main focus is on the Inuvik to Tuktoyaktuk road project, assuming a 60 km/hour design standard, a seven-year construction period, and a 20-year operational period. It also addresses a community construction approach to the project in which the highway will be built in small increments over an extended period.

Project Benefits

Key respondents identified a range of project benefits. They are listed below:

- Prices in Tuktoyaktuk are expected to decrease as transportation and storage costs are reduced and

more movement of persons between Inuvik and Tuktoyaktuk increases price competition.

- Tourism is expected to increase as the ability to drive to the Beaufort Sea furthers the appeal of the Inuvik region. This will lead to increased tourism spending.

- People, businesses, and public sector organizations including the health system in Tuktoyaktuk will have increased access to Inuvik, the regional centre. This will likely mean an increase in operating efficiencies. Individuals are expected to travel more frequently between the communities, reducing their isolation.

- The Department of Transportation will not have to maintain an ice road between Inuvik and Tuktoyaktuk.

- Tuktoyaktuk and Inuvik will have increased access to gravel and sand resources.

The road is not expected to increase the likelihood of oil and gas or fisheries development in the region. If these resource developments were to take place, the road may increase access and the efficiency benefits will increase. However, there are no indications that further oil and gas will take place in the foreseeable future.

Some identified benefits were not further quantified because no ready market value estimates were available. These include the anticipated increase in the quality and variety of goods available in Tuktoyaktuk and the increased access for hunters and trappers.

Project Costs

The Department of Transportation developed a preliminary construction cost estimate. Other costs are incurred as well because you additional money will have to spent to realize some of the benefits. The cost are listed below:

- The total construction cost of the road is estimated at $100 million. This assumes a 60 km./hour design standard. The Department also developed a $135 million cost estimate for a road with an 80 km/hour design standard. The $100 million cost was used in the analysis.

- Maintenance of the all-weather road is estimated at $10,000 per kilometre or $1.4 million per year.

- The tourism industry will need to spend money to supply the products desired by visitors. This include the cost of restaurant meals, tour operator supplies, wholesale grocery, and bulk fuel.

- Increased mobility implies costs, including additional ground transportation costs and increased accidents.

Some costs were not quantified because no market values are available. These include the cost of increased hunting and trapping pressure and possible impacts of the road on wildlife migration patterns.

Benefit-Cost Analysis

The benefit-cost analysis compares the discounted benefits and costs of the Inuvik to Tuktoyaktuk road project. The discounted benefits need to be greater than the discounted costs for the project to be economically viable. A benefit-cost ratio of one or larger and a positive value of the net present value of the difference between the costs and benefits indicates economic viability.

The benefit-costs ratio of the project is estimated at 0.26, assuming a 7.5% discount rate, and the present value of the net benefits is estimated at minus $66 million. This means that the project is not viable from a strict economic perspective.

This result is in line with other assessments of the economics of the Inuvik to Tuktoyaktuk and similar roads, which yield benefit cost ratios ranging from 0.11 to 0.27.

However, many public investments in infrastructure and programs are made on the basis of social rather than economic considerations. The regional economic impact analysis looks at the project from a regional development perspective, focusing on redistributing economic activity and benefits among regions.

Regional Economic Impact Analysis

The project will generate employment and income benefits to the region in the following ways:

- local hiring of construction workers and project spending on wages, materials, and equipment during construction;
- increased local hiring of maintenance workers and spending on wages, materials, and equipment for the maintenance of the all-weather road as compared to annual spending on the ice road; and
- increased tourism spending accruing to local operators and their suppliers.

These regional construction impacts are estimated at:

- $77 million of business and labour income; and
- 600 person-years of on-site employment.

Much of the business income will leave the regional economy as payment to suppliers, including equipment lease payments. These economic impacts accrue to the region over the seven year construction period. Considering the limited annual construction period, the project's construction may require some 170 workers per year, or 8% of the total workforce. The project could also provide additional training positions for persons interested in equipment operations and the heavy duty mechanics trade.

The ongoing road maintenance will also provide economic benefits. These are estimated at:

- additional business and labour income of $1.1 million per year;
- additional employment of five person-years per year.

The anticipated increase in tourism will increase the employment opportunities in the region. This may eventually reach an additional 50 person-years of employment by 2025.

Seen from a regional perspective, the project strengthens the local economy by providing additional business and labour income and by creating additional jobs. This is significant for the Inuvik Region, which has unemployment levels well above those in, for example, Yellowknife.

Assuming that the project is financed from outside the study area, the employment and income benefits will be without cost to the region. This

means that the project will lead to a redistribution of income within the Northwest Territories. The redistributive effect of the project is reduced if it is financed in part by regionally-based organizations. In that case, the project would likely pre-empt other investment in the region.

Community Construction Approach

It is possible to construct the road not as a short-term construction project, but as a long-term regional development initiative. The community construction approach, which would mean the construction of about one kilometre of road per year, has the following annual economic impacts:

- additional business and labour income estimated at $75,000; and
- additional employment estimated at 6 on-site person-years.

The community construction approach would contribute to the economic development of the region, but on a much reduced scale as compared to the seven year construction scenario. It would:

- provide a modest stimulus to the regional economy, a policy goal that may be of interest to the government of the NWT; and
- provide some training opportunities for local people, - especially if a way can be found to deliver the appropriate trades training in the region.

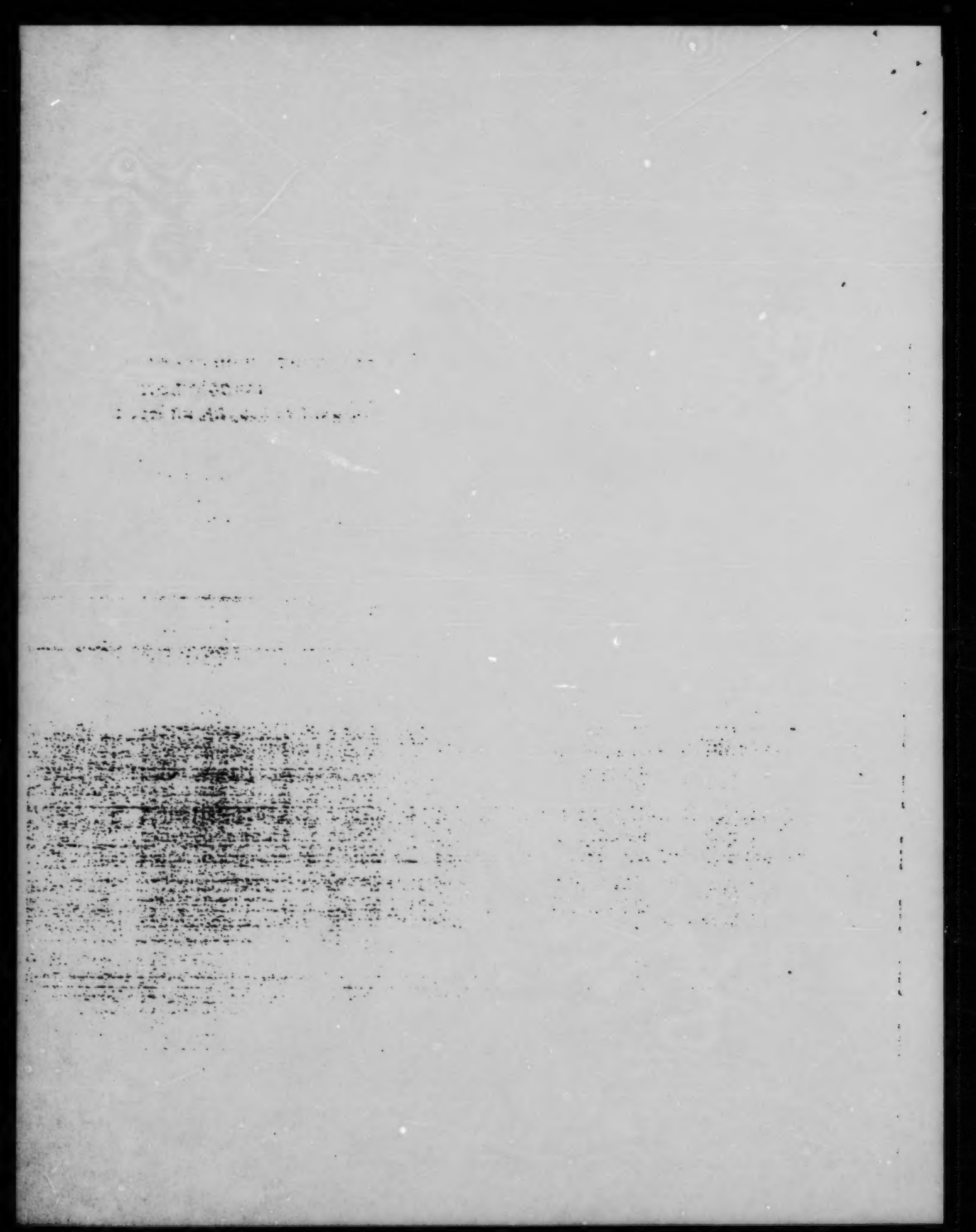
The community construction approach would not place any undue stress on the labour market of the region and provide one or maybe two training positions for equipment operators and heavy duty mechanics.

Conclusion

The construction of the Inuvik to Tuktoyaktuk road can be a tool for regional economic development. It provides income and employment opportunities during construction and operation and will contribute to the further development of the tourism industry in the region.

The project is not attractive from a strict economic perspective. Its strengths are in the redistribution of wealth rather than in creating it.

C.6 Executive Summary of the Financing Study Inuvik Tuktoyaktuk Road



FINAL REPORT

HIGHWAY FINANCING STUDY

Submitted to

Government of the Northwest Territories
Department of Transportation

by

Nichols Applied Management
Management and Economic Consultants
Edmonton Calgary

August 1999

EXECUTIVE SUMMARY

This study of highway financing in the Northwest Territories (NWT) is part of the 1998/1999 Highway Strategy Initiative of the Department of Transportation of the Government of the Northwest Territories (GNWT). The results of this study and others undertaken as part of the initiative will be used to develop project concepts, information data bases, and to further the plan for advancing new road projects.

The study approaches financing of the Inuvik to Tuktoyaktuk Road and the Mackenzie Valley Highway Extension in two ways. First, it provides an overview of financing and revenue-generating options used in Canada and the U.S. and discusses their applicability to the situation in the NWT. Second, it gives an overview of currently available programs that could be used to reduce the total highway construction costs and reports on the discussion with regional claims organizations regarding their potential involvement in the projects.

Traditional Highway Financing

Most highway construction in Canada is done using public tenders, financed out of provincial government budgets. This approach to highway construction would imply an annual construction budget of between $10 million and $80 million for five to 10 years to build the $100 million Inuvik to Tuktoyaktuk Road or the $220 million to $400 million Mackenzie Valley Highway Extension. The cost of the latter project depends on its final configuration. Such commitments are well beyond the capacity to the Department of Transportation, which has a total annual budget of $66 million, $17 million of which is allocated to the highway construction, mostly rehabilitation of existing roadways.

There is limited capability in the NWT to finance the projects by issuing debt. The size of the NWT economy limits the ability of the GNWT to repay debt. In addition, the GNWT does not have a history of debt issuance and repayment, reducing the likelihood of success of any forays into the capital or debt markets.

Financing Alternatives

Other jurisdictions in Canada and the US have tried new ways of infrastructure financing and have explored new or enhanced revenues associated with highway projects. They are summarized in the following table, which also discusses their applicability to the NWT.

Summary of Financing and Revenue Generating Alternatives	
Source of Capital/Revenue	**Applicability to NWT**
Private Equity/Debt	Limited. Projects have a very limited ability to provide the desired rate of return on the private investment.
Grant Anticipation Revenue Vehicle	Very limited. DOT funds for highway construction are committed in the near and intermediate terms.
Gaming Revenue	Very limited. Only $100,000 in licensing fee income flows into general revenue.
User Tolls	Very limited. Low utilization of roads.
Shadow Tolls	Limited. GNWT budget insufficient to provide payments to compensate private sector developers.
Registration Fees	Very limited. Low number of vehicles in the NWT. Used mostly in urban or densely populated areas.
Parking Charges	Very limited. With a few exceptions, no parking charges are levied in the NWT. Used mostly in large urban areas.
Area Licensing/Permit	Very limited. Designed to reduce congestion, which is not an issue in the NWT.
Fuel Tax	Limited. A 10% increase in all fuel taxes would raise not more than $0.7 million per year.
Sales Tax	Limited. Potential to generate revenue is offset by the low level of public acceptance.
Motor Vehicle Property Tax	Very Limited. Low revenue potential due to the limited number of cars.
Special Assessment District/ Tax Increment Funding/ Offsite Levy	Very Limited. Low traffic volumes will limit the likely development along the highways.
Development Agreement	Limited. The oil and gas industry, which is likely the most active industry in the area in the near and medium term, is not dependent on a road.

The information in the table supports the conclusion that the projects will not be built using a public tender approach without considerable infusion of public money. In this regard, there are a number of reasons for federal involvement, including the federal mandate for economic and resource development and the federal responsibility for new highway construction in the NWT.

Community Construction Approach

The Community Construction Approach phases the construction over 30 years or more, reducing the annual construction costs to $2 million to $4 million. It is a way in which some new Department of Transportation money can jumpstart the projects. The projects can then be used to present training and business development opportunities for local area people and businesses.

The Community Construction Approach provides possibilities for using existing training and business development programs to augment the annual Department of Transportation contribution. Programs that may be used as part of the Community Construction Approach include:

Summary of Programs

Program	Selected Services
Business Credit Corporation (RWED)	• Loans to business enterprises. • Loan guarantees and business bonds.
Business Development Fund - (RWED)	• One-time assistance with business planning/development costs. • Assistance with the acquisition or development of capital goods. • Venture capital assistance. • Assistance to upgrade business skills.
Training-on-the-Job (ECE)	• 60% of trainee's gross salary to a maximum. • Tuition reimbursements to a maximum.
Working Together (ECE)	• Up to $5/hr (or 90% of minimum wage) for a student or youth worker. Maximum contract: one year.
Building and Learning Strategy (ECE)	• Training costs for trainees. • Wage subsidy to the contractor.
Skills for Work (ECE)	• Training costs for trainees. • Wage subsidy to the contractor.
Apprenticeship Training Program (ECE)	• Wage subsidy for apprentices over a three-year period. The maximum subsidy is reduced as the apprentice gains experience and becomes more productive.
Employment Insurance Training (ECE/HRDC)	• Training allowance of $675/week. • Additional support is available for tuition, transportation to the place of instruction and childcare.
Indian Management Assistance Program (DIAND)	• Wage subsidy for a university student who works for an aboriginal groups in a managerial role during the summer months.
Business Opportunity Fund (DIAND)	• One-time funding to the aboriginal group desiring to undertake an appropriate business venture.
Aboriginal Human Resources Strategy (HRDC)	• Employment programs that reflect and serve Aboriginal needs at the local labour market level. • Local board accepts and evaluates proposals for training and labour market development programs.

There may be options for future private sector involvement in training and labour force development through benefit agreements. This option is very dependent on further resource development in the region.

There are several limitations to this approach, including:

- training programs tend to subsidize only part of the wage costs incurred and wage costs account for only about one-third of construction costs;
- training budgets are constrained and often include a geographic distribution of program expenditures;
- the eligibility of the project work forces for training assistance will reduce over time as their training levels increase; and
- only one program that assists with the purchase of equipment was identified and none that help with equipment operating costs.

These observations notwithstanding, the Community Construction Approach offers opportunities for regional economic development.

Claimant Groups

The affected claimant groups will need to be involved in the projects. The proposed highways cross Inuvialuit, Gwich'in and Sahtu lands and the claims organizations represent the people who will most benefit from the highway projects. They are also the major source of investment capital in the region.

Discussions conducted as part of this study indicate an interest by the claims organizations to be part of the projects. The exact nature of their involvement will need further discussions, but possibilities include resource royalty waivers and equity participation.

Conclusion

Building the Inuvik to Tuktoyaktuk Road and the Mackenzie Valley Highway Extension using a traditional Public Tender Approach will require substantial new public money. This suggests that the GNWT

should continue to work with its provincial counterparts to ensure that the federal government meets it's mandate for economic and resource development and responsibility for new highway construction in the NWT.

Short of that, The Community Construction Approach is an alternative in which the Department of Transportation can jumpstart the projects, using some additional highway construction funds. The projects can then provide a vehicle for local access to existing government training and business development programs, creating regional economic development with a highway construction focus.

The department will need to continue to work with the claimant groups to explore their role in more detail. Showing a government commitment to a sustained economic development process using highway construction as a focus may be an inducement for claims groups to enter into the discussion. Any equity participation by these groups may augment and enhance the government-sponsored construction activity. It could also replace it, with the public funds then allocated to shadow tolls to compensate investors.

The Community Construction is not incompatible with the Public Tender approaches. With a modest budget reallocation, the Community Construction Approach can be initiated in the near term. It can be scaled up if claims groups become actively involved. Then, if changes in the fiscal situation of Canada and the NWT will allow new public investment in infrastructure, the Community Construction Approach can be superseded by the Public Tender Approach.

C.7 Executive Summary of the Land Issues Study Inuvik Tuktoyaktuk Road

Identification Of Land Tenure Options and Issues Respecting Inuvialuit Owned Lands: Inuvik to Tuktoyaktuk Road

Transportation Planning Division
Department of Transportation
Government of the NWT

EXECUTIVE SUMMARY

Submitted By:

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October, 1999

EXECUTIVE SUMMARY

Terriplan Consultants Ltd. was retained by the GNWT Department of Transportation, Transportation Planning Division, to research and document potential options to secure land tenure for the construction and operation of an all-weather road between Inuvik and Tuktoyaktuk. The scope of the project was limited to land use and administration issues, respecting Inuvialuit owned lands and does not purport to provide any legal advice related to land tenure - as a condition, or form of right or title, under which property is held.

The methodology included extensive literature searches and review, consultations with appropriate Inuvialuit organizations, federal and territorial government departments, and interviews with transportation agencies in other jurisdictions to bring additional perspective to the assessment of land tenure options.

The original road alignment proposed by Public Works Canada in 1977 passes through federal Crown land, Commissioners's land, Gwich'in Settlement lands (privately held) and Inuvialuit owned lands (privately held). The research focused only on Inuvialuit owned lands, while the other land owners will be addressed within other clearly established legal procedures at the appropriate time.

The total distance of the proposed road is 140 km and is designed with a 60 m right-of-way covering some 840 ha of land. 91.6 km of the road, representing 65 percent of the total length, are on Inuvialuit owned lands. The total amount of Inuvialuit land affected by the road is 550 ha.

The proposed road construction cost is estimated at $100 million, with annual maintenance costing some $1.4 million. Independent analysis conducted by Nichols Applied Management concluded that the benefit-cost ratio of the road is 0.26, assuming a 7.5% discount rate, and the present value of the net benefits is minus (-) $66 million. This indicates that the project is not viable from a strict economic perspective. Recognizing that many public investments in infrastructure and programs are made on the basis of social as well as economic considerations, the proposed road project will have a significant regional development impact, including: $77 million in business and labour income and 600 person years of employment during the construction stage.

The Inuvialuit Final Agreement (IFA) and the Inuvialuit Lands Administration (ILA) *Rules and Procedures* provided a key part of the framework for examining conveyance, expropriation and acquisition of rights through a lease, rental or other instruments. The IFA does not formally recognize the GNWT, and therefore does afford the same opportunities and rights with respect to land access and usage that are provided to the federal government. This is a key factor in the consideration of potential land tenure options.

The GNWT has a number of interests with respect to local roads and highways. This includes an interest to guarantee unrestricted and equal public access, benefit and enjoyment of publicly financed highways that establish transportation links between communities, settlement areas and adjacent provincial and territorial highway networks. Central to these interests are questions respecting title, benefits and use of highways.

The experience of transportation agencies in other jurisdictions indicates that road projects affecting, crossing or located on Aboriginal lands are now emerging as part of the new operating environment and that jurisdictions are gradually making the necessary internal policy and organizational adjustments. There is emerging interest and commitment to fully recognize and treat First Nations as private land owners, with the requisite rights, privileges and obligations, in land access and tenure negotiations.

The land access and acquisition process respecting Aboriginal lands in other jurisdictions is dominated by complex legal considerations, while transportation planning and design factors have generally played a secondary role. Negotiation periods of up to a decade are not unusual. The general absence of a cohesive policy framework to guide land access and tenure issues respecting Aboriginal lands is clearly a critical factor.

The Department of Transportation initially identified four possible land tenure options for consideration: land purchase; land expropriation; land exchange; and land lease. The key findings for each option include:

Land Purchase: The IFA currently allows Inuvialuit lands to be conveyed only to Inuvialuit persons or corporations, or to the federal Crown. It may be possible to consider requesting that the subject lands be purchased by the federal government from the Inuvialuit and in turn transfer the lands to the Commissioner of the NWT, or to consider an amendment to the IFA to allow this option to be pursued.

Land Expropriation: For purposes of a comparative analysis the option of outright expropriation was deemed to be distinct from a land exchange agreement, fully recognizing that the result would be similar in that there is a transfer of title and rights. The IFA states that only the federal government has the right to expropriate Inuvialuit lands. The GNWT does not have direct expropriation rights but rather would have to request the federal government to do so on its behalf. There has never been an expropriation of any lands within the NWT, including the Inuvialuit Settlement Region, by either the federal government or GNWT.

Land Exchange: While the existing provisions of the IFA preclude the GNWT from engaging in a direct land exchange with the Inuvialuit, it is possible to seek an amendment to the IFA that would facilitate this direct type of land exchange. The preliminary evidence compiled during this project does not permit a conclusion to be drawn respecting the willingness of both the Inuvialuit and the

federal government to undertake such an amendment. However, the option clearly does exist for the GNWT to request that the federal government undertake a land exchange on its behalf.

Land Lease: The IFA allows for the GNWT to enter into a long term lease (up to 50 years with options for renewal) for a *Public Right-of-Way* with the Inuvialuit. There are a number of existing specific terms and conditions associated with a *Public Right-of-Way* as defined in the Inuvialuit Lands Administration Rules and Procedures, including but not limited to: maximum term for a lease, maximum right-of-way allowed for a public road, required security deposits, lease costs and "Variable Terms and Conditions". The legal status of the Rules and Procedures require clarification.

Depending on the decision taken by the GNWT or other developer as to whether to proceed with construction of the road and when, government and third party interests and constraints will have to be fully considered and documented at that time in the context of any particular option which is pursued. This should include a comprehensive review of rights, interests, commitments and activities on the subject lands, including consideration of government and Inuvialuit rights granted to third parties.

D. Mackenzie Valley Highway Extension

D.1 Consultations

An initial Stakeholder Workshop was held in Norman Wells on June 8, 1999. The workshop was attended by approximately 60 stakeholders and generated considerable discussion on the need-for, and benefits-of, an all-weather road.

A meeting with the Sahtu Secretariat and the Sahtu Regional Land Corporation Presidents was held on November 12, 1998. The group reviewed the Terms of Reference for Environmental Scoping and Benefit Cost Studies. The Terms of Reference were also sent to other stakeholders invited to participate on the Advisory Committee.

In December the Department established an Advisory Committee for this project consisting of 25 individuals representing a wide variety of interest groups and organizations. The Department has kept this committee informed of the status of projects, and held a meeting on March 17, 1999 in Norman Wells. A list of the committee members is provided below.

- Sahtu Secretariat Incorporated, Ruby McDonald,
- Deline Land Corporation, Raymond Taniton,
- Fort Good Hope Metis Nation Local #54 Land Corporation, Wilfred McNeely Jr.,
- Ayoni Keh Land Corporation (Colville Lake), Wilbert Kochon,
- Yamoga Land Corporation (Fort Good Hope), John Louison,
- Tulita Land and Tulita District Land Corporation, Gordon Yakeleya,
- Fort Norman Metis Local #60 Land Corporation, Eddie McPherson Jr.,
- Ernie McDonald Land Corporation (Norman Wells), Winter Lennie,
- Gwich'in Tribal Council, Richard Nerysoo,
- Town of Inuvik, George Roach,
- Charter Community of Arctic Red River, Grace Blake,
- Village of Fort Simpson, Norman Prevost,
- Deh Cho First Nation, Mike Nadli,
- Fort Simpson Chamber of Commerce, Andrew Gaule,
- Pehdzeh Ki Dene Council (Wrigley), Tim Lennie,
- Hamlet of Tulita, Bertha Lennie,
- Tulita Dene Band, Frank Andrew,
- Charter Community of Deline, Raymond Taniton,
- Deline Dene Band Council, Raymond Taniton,
- Town of Norman Wells, Frank Pope,
- K'asho Got'ine Charter Community Council (Fort Good Hope), Charlie Barnaby,
- Imperial Oil, Reg Wisener
- NWT Construction Association, Richard Bushey,
- NWT Trucking Association, Ray Anderson
- Norman Wells and District Chamber of Commerce, Kevin Diebold

Formal public consultations were undertaken as part of the Environmental Scoping Study. Public meetings were held in the communities noted below.

- Fort Simpson – March 3, 1999
- Deline - March 8, 1999
- Tulita – March 9, 1999
- Norman Wells – March 11, 1999
- Wrigley – March 29, 1999
- Tsiigehtchic – April 12, 1999
- Inuvik – April 14, 1999
- Fort Good Hope – April 20, 1999
- Colville Lake – April 22, 1999

Key stakeholder consultations were also undertaken as part of the Benefit Cost Analysis and Financing studies. These were held both in-person and by telephone.

D.2 Studies Undertaken

Summaries of the following four studies undertaken by the Department on the Mackenzie Valley Highway Extension are attached.

- Environmental Scoping Study
- Engineering Update Study
- Benefit Cost and Economic Impact Analysis
- Financing Study

D.3 Executive Summary of the Environmental Scoping Study Mackenzie Valley Highway Extension

GEO NORTH

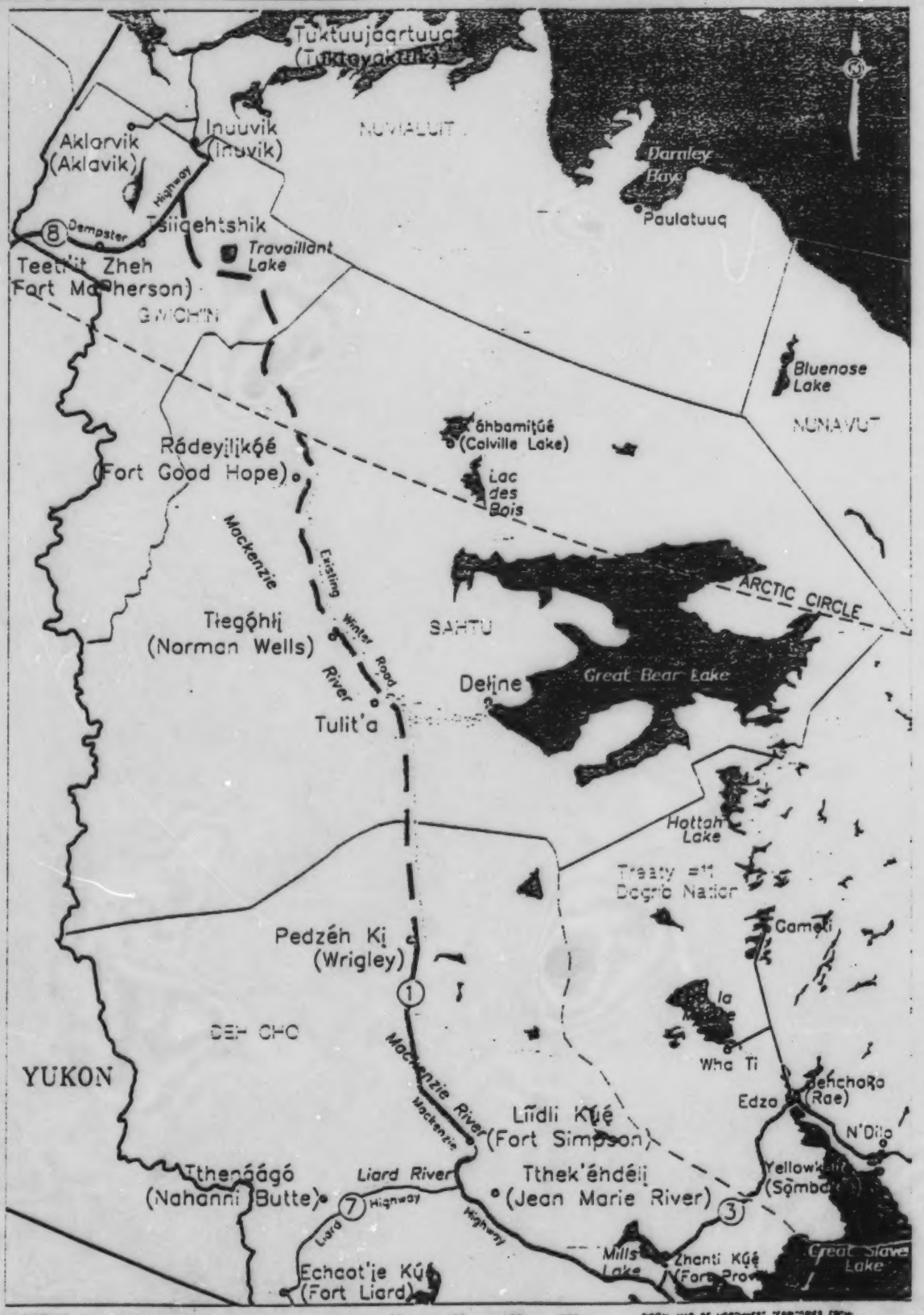
Golder Associates

Mackenzie Valley Highway Extension: Scoping, Existing Information and the Regulatory Regime

prepared for
Department of Transportation
GNWT

prepared by
GeoNorth Limited
and Golder Associates

September 1990



DIGITAL MAP OF NORTHWEST TERRITORIES FROM SELECTED MINERAL DEPOSITS OF THE NORTHWEST TERRITORIES DEPARTMENT OF ENERGY, MINES AND RESOURCES, MINERAL ACTIVITIES 1991 TO 1995, REVISED OCTOBER, 1996. INFORMATION MANAGEMENT GROUP, DIAND (Sept. 5/96)"

CONCEPT FOR AN ALL WEATHER HIGHWAY EXTENSION FOR THE MACKENZIE VALLEY

Executive Summary

1.1 Introduction

At present the communities of Tulita, Deline, Norman Wells and Fort Good Hope can only be reached by road in the winter, and the only all weather road to Tsiigehtchic and Inuvik is the Dempster Highway via the Yukon. The concept under consideration is an 804 km extension of the Mackenzie Highway north from Wrigley to the Dempster Highway, with a possible 105 km side route to Deline. This report is one of four related studies being conducted by the Government of the Northwest Territories (GNWT) Department of Transportation (DOT) to see if, from a range of perspectives, it makes sense to link these communities with an all weather road. The other studies include a benefit–cost analysis, engineering and financing.

At this time such an extension is only a concept to be evaluated, not a formal project proposal. The purpose of this Mackenzie Valley Highway Extension (MVHE) study was to:

- Undertake, and report on, community and other stakeholder consultation to scope issues;
- Collate existing information on the project area and evaluate its likely usefulness in a future environmental impact assessment (EIA) process, should the extension become a firm project;
- Examine regulatory requirements for the project;
- Identify information gaps and make recommendations on future work that would be needed to fill those gaps to meet EIA needs.

1.2 Environmental Issue Scoping

'Scoping' involves a preliminary identification and analysis of issues that may have to be assessed during an environmental assessment. Through environmental scoping communities along the proposed MVHE were given a preliminary opportunity to identify and discuss issues surrounding the construction and operation of the highway. Environmental scoping sessions (public meetings) were held in Fort Simpson, Wrigley, Tulita, Deline, Norman Wells, Fort Good Hope, Colville Lake, Tsiigehtchic and Inuvik. In addition, Elders were interviewed regarding their traditional knowledge, and other technical experts and stakeholders were consulted.

During community scoping sessions the majority of participants were more interested in discussing whether they were for or against the project, rather than covering specific environmental or social issues. The economic benefits that could accrue to a community through training and employment opportunities were foremost in their minds. Communities generally favour construction over approximately a 10 year period using the 'community construction approach'. Their belief in the potential for the MVHE to

stimulate the regional economy in terms of resource development and the tourism industry was emphasized. However, many participants did raise concerns about social and environmental impacts of the project.

Communities within the Mackenzie Valley (Fort Simpson, Wrigley, Tulita, Norman Wells, Fort Good Hope, Tsiigehtchic and Inuvik) all support the extension for the resource industry and tourism business that could be generated. It is recognized that along with greater access could come social problems related to alcohol and drugs, but most communities are confident that they are more capable of planning for and dealing with these negative effects than they were in the 1970s. The main environmental concerns regarding improved access include various potential negative effects on fish and wildlife habitat and populations.

Residents of Colville Lake have mixed feelings about the MVHE, (because of concerns about social impacts on their community and concerns that people from Fort Good Hope will benefit the most) and cannot readily agree to the project without knowing the opinions of other communities. Elders in Deline were firmly opposed to a spur road linking their community with a highway through the valley, largely because of the perceived negative social impacts to traditional activities. However, neither Deline nor Colville Lake residents expressed opposition to an all-weather highway linking other communities down the Valley. Some residents of Tsiigehtchic prefer an alternate alignment southwest of the Mackenzie River so as to avoid impacts on the Travaillant Lake area that lies northeast of the Mackenzie. A strong message from the scoping sessions is that DOT should commit to future community consultations on all aspects of the project if it becomes a reality, with respect to training and employment for construction, and traditional knowledge with respect to route alignment and stream crossings.

In addition to the public meetings that many Elders participated in, an attempt was made to interview three Elders in each community with respect to their traditional knowledge (TK). Elders remember previous pipeline and highway projects and the social impacts they had on Mackenzie Valley communities, and do not want the impacts to be repeated. They see an opportunity for short-term employment and training benefits, but are concerned about the long-term. They have many concerns about impacts of the MVHE on their traditional life, and feel that increased access would bring an increase in drugs and alcohol. They have more specific concerns about impacts on fish and wildlife habitat, and traditional burial sites.

Consultations with government technical authorities, co-management bodies, and non-governmental organizations tended to focus on the possible direct impacts on the ecosystem, and the mitigation measures necessary to minimize these effects. Moose, caribou and bears are wildlife species of concern, considering the possible influence the MVHE could have through mortality related to collisions, legal and illegal harvesting, and through disturbance. Increased access to fish resources and the cumulative effects of disturbance to streams crossed by the highway, are also issues of concern. The Mackenzie Valley is valuable migratory and breeding habitat for songbirds, waterfowl

and raptors. Technical authorities provided a number of suggestions for minimizing potential impacts to these species, particularly during the construction phase of the MVHE.

1.3 Existing Data Collection

It is important to maximize the use of existing information, to efficiently plan for environmental impact assessment (EIA) of the MVHE project. A bibliographic database was created for the study area by means of searches of both electronic and conventional written information sources. Disciplines covered included socio-economic, historical/cultural and biophysical discipline areas. To be included, references needed to be of relevance to the MVHE corridor and address issues pertinent to the development of an EIA for the road. After editing out inappropriate citations, the database comprised just under 1200 records. The database is provided in printed form as an appendix to this report and also as an electronic database searchable by key words.

Records were ranked as to their utility to help with preparation of an EIA; classes were high, medium, low and indeterminate. Criteria for ranking references varied by discipline, but in general more useful references were focused on the potential development corridor and were not too old. The following details summarize the information found:

- One hundred and eighty-three references contained relevant socio-economic information; of these 148 also overlapped with other discipline areas. Only 35 were ranked as of high use for EIA purposes.
- Three hundred and ten historical/cultural references are included in the database, 125 of which also included information on other areas. Thirty-four were deemed of high use for EIA purposes.
- Biophysical references were the most common, with 768 biophysical only references and 150 including information on other disciplines. Four hundred and ten of the biophysical only references were classed as of high use in EIA preparation.

A selection of key references were reviewed in more detail, especially those related to the previous road and pipeline corridor planning in the Mackenzie Valley during the 1970s and 1980s, plus more recent reports. These references, plus abstracts for other citations, were used to gauge the adequacy of existing information for EIA needs, as detailed in Section 6 of this report.

1.4 Regulatory Regime and Environmental Impact Assessment

The regulatory and environmental impact assessment regime in the NWT has evolved in recent years with the settlement of some land claims and the proclamation of the Mackenzie Valley Resource Management Act (MVRMA).

Various acts and regulations require a proponent to obtain permits for field studies conducted in support of the environmental impact assessment. The major part of the regulatory regime however, comes in to play with the EIA process. Once approval for the project is received the proponent would require a number of authorizations, permits or licences.

These include a water licence for the use of water and discharge of waste, as well as for the installation of bridges or culverts if the watercourse is more than 5m wide. Conditions of the water licence include criteria required for drinking water, for the discharge of water, and for abandonment and restoration. Permission is required under the Fisheries Act and the proponent is responsible for identifying the habitats potentially affected by the project, assessing the potential for each fish species of concern and developing mitigation alternatives. An approval must also be received from the Canadian Coast Guard for the placement of any structure that may interfere with navigation, such as a bridge or culvert, in a navigable water.

Land use permits for Crown and First Nations lands are issued for short term construction activities (five years or less, with possibility of extension for up to two more years) by the Gwich'in and Sahtu Land and Water Boards and, after Part IV of the MVRMA is proclaimed, the Mackenzie Valley Land and Water Board. These permits would contain operating conditions that the proponent must adhere to, as well as dealing with reclamation issues. A number of land use guidelines are produced by the Department of Indian Affairs and Northern Development (DIAND) on topics such as reclamation, access roads and trails, and pits and quarries. In addition to a land use permit, quarry activities also require a quarry permit if located on Crown land. On Sahtu or Gwich'in owned land, the First Nations are entitled to compensation for construction materials obtained from their land. GNWT, Municipal and Community Affairs (MACA) currently issues land use and quarry permits for Commissioner's Land, although this process currently is subject to negotiation with the land and water boards.

Cultural resources are protected by the permits required to conduct a study, by the need to conduct an assessment of the historical potential of a site during an EIA, as well as by terms and conditions applied to land use permits.

The EIA conducted for the project, if it is proposed, would proceed under the MVRMA. Under this regime, the first stage of EIA is preliminary screening. This is usually conducted by the land and water boards, but the permitting authorities (e.g. Fisheries and Oceans (DFO), DIAND, Natural Resources Canada (NRCan)) may also conduct a screening although this is unlikely if their concerns are given due consideration by the land and water board(s). The proponent must demonstrate that it has permission of the land owner to proceed with the development. The project is also checked against any land use plans to ensure conformity. The preliminary screeners must decide if the project might cause significant adverse environmental effects or public concern. If so, the project is referred to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) for environmental assessment (EA). The scope of this project, and public

interest associated with it, makes it likely that it would be referred for environmental assessment.

The MVEIRB would conduct the environmental assessment and make its decisions based on the preliminary screening report, information supplied by the proponent, public input, as well as expert advice the MVEIRB may seek. The MVEIRB may ask the proponent to prepare an environmental assessment report, according to terms of reference supplied by the Board, if the information provided at preliminary screening is not adequate to conduct the environmental assessment. The MVEIRB has several options for a decision on the environmental assessment. If the MVEIRB is satisfied the development produces no unacceptable impacts or significant public concern, it would likely recommend conditional approval of the project. If significant adverse environmental effects are likely or there is significant public concern, MVEIRB may send the project for environmental impact review. If likely impacts are very severe the project could be rejected.

Environmental impact review involves the formation of a review panel appointed by the MVEIRB. The review panel functions under terms of reference set by the MVEIRB in consultation with the responsible minister and the Gwich'in, Sahtu and Deh Cho First Nations. An environmental impact statement may be requested of the proponent by the review panel if the information already provided is not sufficient to conduct the review. This decision may involve public input. The review panel is required to consider additional matters to those considered during the environmental assessment including the purpose of the development, alternative means of achieving this purpose, and the need for follow-up programs. The panel would either recommend project approval (likely with mitigation measures) or that the project be rejected. Unless serious issues arise during the review, it is likely the review panel would recommend project approval under the condition that appropriate mitigation measures are identified and adopted. The federal minister may adopt the review panel's recommendation (with or without modifications) or reject it. Modifications to or rejection of the recommendation requires the minister to consult with the review panel.

During all stages of environmental impact assessment, decision makers are directed by the MVRMA's guiding principles (laid out in Part V of the Act), and by the requirement to not cause unacceptable significant adverse environmental impacts, or harm the social, cultural and economic well-being of residents and communities of the Mackenzie Valley.

1.5 Information Gaps and Needs

In this Section the adequacy of existing information is compared against expected EIA requirements. Recommendations are then provided as to future studies needed to fill data gaps.

Biophysical references were sub-divided into a number of disciplines to identify information gaps. Those disciplines were climate, geology/soils, hydrology, water quality, fisheries, vegetation/wildlife habitat and wildlife.

It is anticipated that there is sufficient climate data available to meet the requirements for an EIA. An assessment of the potential effects of climate change on the road should also be conducted though, to ensure that the road is best designed to meet any potential changes in snow fall, stream flows and distribution of permafrost.

The geology/soils reports provide varying levels of information, in some cases quite detailed while in others too general to have any direct applicability. Due to the age of some of the studies, 25 years or more, there may well have been ensuing changes to the vegetation cover in some areas that in turn may have affected active layer dynamics and, therefore, which construction techniques might be appropriate. It will still be necessary to compare data with a specific proposed alignment and plan appropriate field programs to acquire geotechnical, soil and terrain data for sections of the route covered either inadequately or not at all in the existing sources.

There were a number of relevant hydrological studies identified that were completed in the 1970s for a proposed highway in the Mackenzie River valley. These studies are good baseline reports, but the hydrology analyses need to be updated with more recent data for accurate modelling that would be needed for design and mitigation purposes. In addition, as noted above the data available on stream morphology and geotechnical information needs to be reviewed in detail, to identify any data gaps that may exist for each finally proposed stream crossing.

Baseline information on water bodies would be collected as a component of the Fisheries and Aquatics baseline study. Much existing water quality information appears to be adequate. Total suspended sediments (TSS) and field measurements (pH, conductivity and temperature) are recommended as part of fisheries investigations. Water quality data would be included as baseline information against which to gauge the efficacy of mitigation, through monitoring programs. Monitoring would likely be an important part of project planning.

While much existing fish biology information is relevant for EIA purposes, a more important need is to address potential concerns regarding fish habitat. Field studies can be implemented that will efficiently address data gaps with an emphasis on habitat for key species. Due to the large amount of existing literature for the Mackenzie River and its tributaries, an exhaustive field program to fill these gaps would not be necessary.

Much of the available information on vegetation and wildlife habitat is from the early 1970s and thus is not current. Updated information is required that would accurately reflect today's conditions. Satellite imagery and linkage to ongoing mapping initiatives such as in the Sahtu (Sahtu GIS Project), would be one cost-effective means of mapping the vegetation along the potential road routes. Development of habitat models for key wildlife species could then be conducted so that quantitative assessments of the effects of alternate road routes on wildlife habitat could be completed. The wildlife habitat maps produced could then be ground-truthed through a stratified survey for key wildlife species.

Information available for wildlife is discussed for birds, ungulates, carnivores and for wildlife harvesting. Some more current route specific information on wildlife habitat and wildlife populations is required to update available data. More community and regulatory consultation should occur to aid in the selection of key wildlife species of concern. Once the species have been selected, habitat maps for each key species should be developed through the use of habitat models and a vegetation map interpreted from satellite imagery, as just described. The road routes could then be analyzed in terms of habitat quality. Some surveys for key species should be conducted, stratified by habitat quality, to verify the models. Particular attention should be paid to habitats considered to be of exceptionally high quality (e.g., important migratory bird sites). Alternate routing to avoid such areas should be considered in the assessment.

Socio-economic topics were grouped for further analysis, as demographics, resources and economics and community services. Demographic data are available, but they should be compiled and analyzed on both regional and community levels. These data form the basis against which to assess both potential positive and negative impacts from the project. The most current data come mainly from the 1996 Canadian census. Analysis of existing resources and economics data is needed to draw an accurate portrait of the Mackenzie Valley economy. This would be necessary as a prelude to quantifying potential project impacts and approaches to mitigation of negative effects and optimization of benefits. Emphasis will be on communities directly on the road route, however additional communities such as Inuvik and Fort Simpson also need to be considered for regional effects analysis. All this data may be obtained from Statistics Canada and the NWT Bureau of Statistics, which have compiled raw data, often at the individual community level. An inventory of existing services and infrastructure may be assembled through recourse to data available from community-based agencies and various GNWT departments. These data are required to allow for a full impact and mitigation analysis for the project. The community wellness study needs to be considered in relation to the monitoring program that should be developed to evaluate the appropriateness and efficacy of the social, economic and cultural mitigation strategies that are implemented.

The last area evaluated concerned historical/cultural sites and traditional knowledge (TK). Because heritage resources are finite and most susceptible to the direct affects of development, accurate information about the location of disturbance zones is one of the most important information needs for an EIA. Maximum use can be made of mapped known sites, both for mitigation and for planning additional field studies. A comprehensive consideration of landscape potential is an important information need in planning effective EIA level studies for archaeology. This would entail compilation of detailed topographic and ecological information for the proposed development corridor, as well as development of systematic criteria for prediction of landscape potential. These data, as well as analysis of the landscape associations of known sites, would permit stratification of the development zones into areas considered to have varying degrees of potential for the occurrence of heritage resources. This would allow planning of effective assessment strategies, focusing on areas warranting greater attention while omitting areas of low potential. It is expected that much of the development zone would have limited

potential, especially in low, water saturated or featureless terrain. Just as for key wildlife species, use of a GIS based predictive model that incorporates heritage potential, along with other environmental concerns, may be the most appropriate planning tool for evaluating the potential effects of the Mackenzie Highway Extension, for structuring EIA related field investigations and for comparative assessment of alternate routes.

Existing TK data are more frequently being mapped on land claim-based GIS systems in the Mackenzie valley. In addition some communities have experience of working on timely focused TK studies to allow mitigation of potential effects of recent oil and gas exploration. A comprehensive understanding of regional traditional land use patterns and of the project related concerns within local communities is an important information need for an EIA. It would be important to use maximally existing information, however even here its interpretation will require community input. In addition it has been accepted practice to involve Aboriginal community representatives in collecting scientific data for an EIA, including archaeology, wildlife and possibly vegetation studies. Provisions for direct participation in EIA studies should be made.

1.6 Conclusions

- There is strong support for the Mackenzie Valley Highway Extension from communities in the Valley that would be linked by the project.
- A spur road to Deline was firmly opposed by that community, but they did not object to the main route in the Mackenzie Valley.
- Residents of Tsiigehtchic are divided regarding the preferred route. Many prefer an alternate alignment southwest of the Mackenzie and would like to discuss that option with residents of Fort Good Hope.
- Full community involvement in subsequent project planning and detailed EIA planning is a priority for all communities.
- A slower community construction approach, over approximately a 10 year period, is generally favoured to maximize community training and employment benefits.
- Much information exists for the project area, some of which, especially in biophysical subjects, would have direct relevance in preparing an EIA, should the project be formally proposed. Even more of the existing information will help in planning focused studies to fill information gaps for the EIA process.
- The new regulatory regime under the MVRMA for an EIA and subsequent permitting has been described. The scope of the project and level of public interest in it, suggest that it would be referred for environmental assessment after initial preliminary screening.
- The amount of new studies required to investigate issues and propose adequate mitigation, varies by discipline. Recommendations are given on the nature and amount of work needed in biophysical, socio-economic and cultural - archaeological areas. Meaningful integration of TK into the EIA process will be necessary.

D.4 Summary of the Engineering Update Study Mackenzie Valley Highway Extension

MACKENZIE HIGHWAY EXTENSION
WRIGLEY TO THE DEMPSTER HIGHWAY

1999 Engineering Update

Prepared by
Highways and Engineering Division
Department of Transportation

June 1999

TABLE OF CONTENTS

	Page
INTRODUCTION	1
PREVIOUS WORK	1
DESIGN STANDARDS	1
BASIS OF COST ESTIMATES	4
Embankment Construction Cost Estimates	4
Structures (Bridges/Culverts) Cost Estimates	5
Engineering Cost Estimates	5
ESTIMATED CONSTRUCTION COSTS	5
Wrigley to Tulita	6
Tulita to Norman Wells	6
Norman Wells to Fort Good Hope	7
Fort Good Hope to Dempster Highway	8
Deline Access to the Mackenzie Highway	9
SUMMARY OF CONSTRUCTION COST ESTIMATES	10
OPERATION AND MAINTENANCE COSTS	11
IMPLEMENTATION AND SCHEDULING	11
TABLE 1, DESIGN PARAMETERS AND PRELIMINARY CROSS SECTION	3
FIGURE 1, LOCATION MAP	2
FIGURE 2, TYPICAL DESIGN CROSS SECTION (60 km/hr Design)	3
FIGURE 3, TYPICAL DESIGN CROSS SECTION (80 km/hr Design)	4

INTRODUCTION

The primary purpose of this study was to update or develop cost estimates for the extension of the Mackenzie Highway from Wrigley to the Dempster Highway and for an access road from Deline to the Mackenzie Highway near Tulita, as shown on Figure 1.

This study is only one of a number of studies undertaken by the Department of Transportation for the completion of the Mackenzie Highway. Other studies which were undertaken include Environmental Scoping and a Benefit/Cost Analysis. The studies will be used for further planning and decision making with respect to the Department's overall Transportation Strategy.

PREVIOUS WORK

The original plan by Public Works Canada was to complete the construction of the Mackenzie Highway from Fort Simpson to the Dempster Highway in a four year period from 1972 to 1976. Although construction did not proceed past a point south of Wrigley, a tremendous amount of engineering and environmental work was done over the entire length of the highway. Pre-engineering and design was basically completed to the "ready to go to tender stage" for most of the highway.

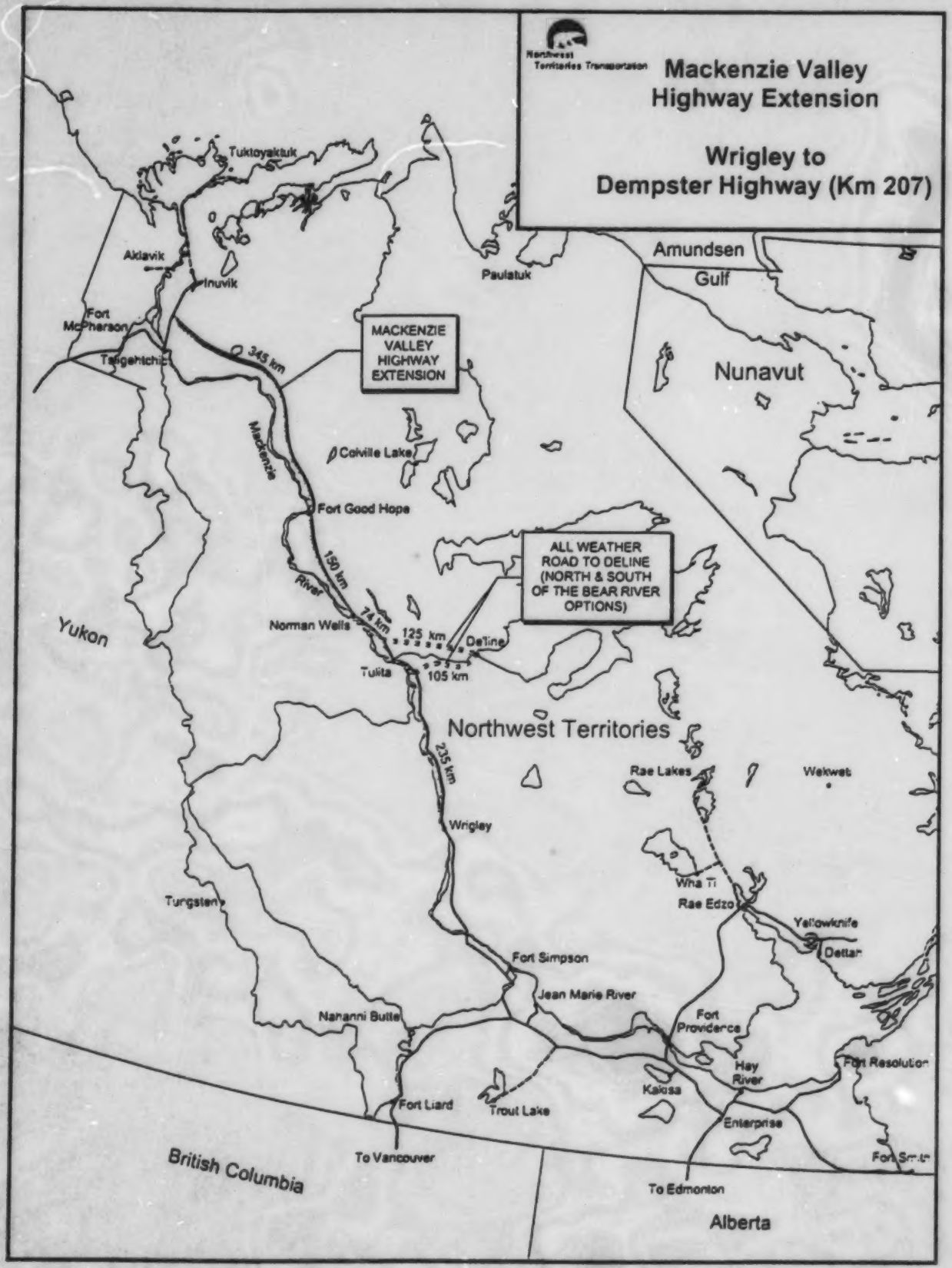
More background and a summary of the Public Works Canada work, along with "updated cost estimates" was presented in a brief 1989 report by the Department of Transportation entitled *Mackenzie Highway, Wrigley to Inuvik Extension*. This report is included in its entirety, with the exception of the pocket map, as Appendix B of this study.

DESIGN STANDARDS

For this study, design standards and resultant cost estimates were developed for two types of all-weather highways; a 60 kilometres per hour highway and an 80 kilometres per hour highway. The design parameters and the design cross sections that were selected for the two types of highway are shown in Table 1.

Calling one a 60 kilometres per hour highway is a bit of a misnomer. In reality, the allowable speed limit would be 80 - 90 kilometres per hour over approximately 95% of the highway with 60 kilometres per hour speed zones through sections of high local relief where the requirements for the vertical alignment and appropriate sight distances have different design parameters..

The main difference in the two designs is the roadtop width. With the 10.0 metre roadtop, the 80 kilometres per hour highway could accommodate the additional granular base required for an asphalt surface without further embankment widening, while the 60 kilometres per hour highway with a roadtop width of 8.4 metre would require widening in order to upgrade to an asphalt surface.

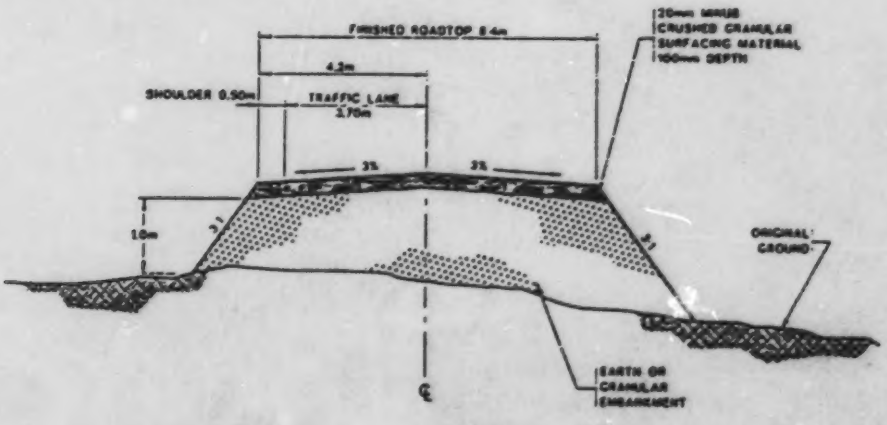

Northwest Territories Transportation
Mackenzie Valley Highway Extension
Wrigley to Dempster Highway (Km 207)
Tuktoyaktuk
Aklavik
Inuvik
Paulatuk
Amundsen Gulf
Fort McPherson
Tsiigehtchic
345 km
MACKENZIE VALLEY HIGHWAY EXTENSION
Nunavut
Mackenzie River
Colville Lake
Fort Good Hope
150 km
ALL WEATHER ROAD TO DELINE (NORTH & SOUTH OF THE BEAR RIVER OPTIONS)
Yukon
Norman Wells
74 km
125 km
Deline
Tulita
105 km
Northwest Territories
235 km
Rae Lakes
Wekweti
Wrigley
Wha Ti
Rae Edzo
Yellowknife
Dettah
Turgsten
Fort Simpson
Jean Marie River
Nahanni Butte
Fort Providence
Hay River
Fort Resolution
Kakisa
Fort Liard
Trout Lake
Enterprise
To Vancouver
British Columbia
To Edmonton
Alberta

With the possible exception of the Great Bear River at Tulita, single lane, timber or steel deck bridges are proposed for all stream or creek crossings. These would be similar to the existing bridges on the highway between Fort Simpson and Wrigley.

TABLE 1
DESIGN PARAMETERS AND PRELIMINARY CROSS SECTION

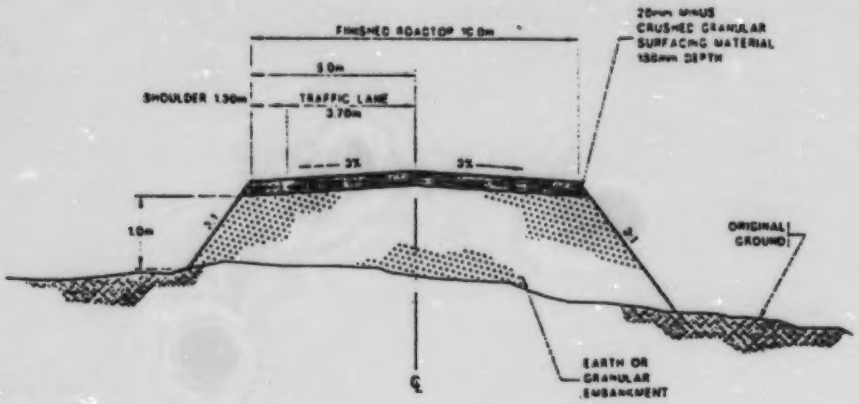
Design Standard	60Km/hr	80Km/hr
Horizontal Alignment		
Min. Radius (m)	120	230
Min. Stopping Sight Distance (m)	85	140
Vertical Alignment		
Sag 'K' Value	20	30
Crest 'K' Value	20	40
Maximum Gradient (%)	10	8
Cross Section		
Roadtop Width (m)	8.4	10.0
Granular Base Course/Surfacing(mm)	100	150
Subgrade Width (m)	9.0	10.9
Minimum Embankment Fill (m)	1.0	1.0
Side Slope Ratio	3 to 1	3 to 1

Figure 2 - TYPICAL DESIGN CROSS SECTION (60 km/hr Design)



60km/hr DESIGN CROSS-SECTION

Figure 3 - TYPICAL DESIGN CROSS SECTION (80 km/hr Design)



80km/hr DESIGN CROSS-SECTION

BASIS OF COST ESTIMATES

The unit cost estimates (per kilometre costs, bridge and culvert costs and engineering costs) which are used in this report were derived, as much as possible, from average costs associated with similar recent highway projects undertaken by the GNWT. These projects include the reconstruction of the Yellowknife Highway (No.3) to Yellowknife, completion of the Mackenzie Highway (No.1) to Wrigley and reconstruction work on the Dempster Highway (No.8). The cost estimates are based on preliminary quantity estimates developed from the Table 1 design parameters and probable construction costs for a project through this area over an eight (8) to ten (10) year construction period based on standard GNWT contracting policies.

These cost estimates do not include any royalties or land acquisition costs that may be payable to First Nation Land Claimant groups. The highway alignment traverses three First Nation Settlement Land areas and any royalty costs for borrow material (if payable) would add substantial costs to the project for this borrow material (general embankment fill and base granular materials).

Embankment Construction Cost Estimates

The estimated per kilometre embankment construction costs provided below for each of the highway sections take into account the variations in accessibility, borrow availability, availability of granular material for surfacing and general topography and terrain types encountered within the sections linking the communities. Embankment construction costs include embankment construction, minor drainage structures (small diameter culverts) and ditching and granular (gravel) surfacing.

Embankment Construction Section	60 km/hr	80 km/hr
• Wrigley to Tulita	$325,000/km	$400,000/km
• Tulita to Norman Wells	$300,000/km	$375,000/km
• Norman Wells to Fort Good Hope	$325,000/km	$400,000/km
• Fort Good Hope to the Dempster	$400,000/km	$500,000/km
• Deline Access (north side of Great Bear River)	$325,000/km	$400,000/km
• Deline Access (south side of Great Bear River)	$275,000/km	$350,000/km

Structures (Bridges/Culverts) Cost Estimates

The following bridge and culvert costs were used for estimating the cost of the structures required for each section of highway.

Bridge/Drainage Structure	Costs
• Single Span, single lane bridges up to 70 m	$14,000 /m
• Single Span, single lane bridges 71m to 100m	$17,000 /m
• Double span, single lane bridges up to 200 m	$6,000,000 /ea
• Great Bear River bridge at Tulita	$12,000,000
• Culverts 1.5 m to 2.4 m diameter	$150,000 /ea
• Culverts 2.5 m to 4.5 m diameter	$300,000 /ea

The above costs do not include design and other associated engineering costs.

Engineering Cost Estimates

Engineering costs for highway construction include all costs associated with geotechnical investigations, preliminary/topographic surveys, highway design, bridge design, contract preparation and construction supervision and administration. Experience in the Northwest Territories and other jurisdictions has shown that these combined costs typically amount to 8 - 12 percent of the project capital costs. In this study, a figure of 10% has been used for the 60 kilometres per hour design and 9% for the 80 kilometres per hour design.

ESTIMATED CONSTRUCTION COSTS

This section provides the estimated construction costs for each of the inter-community sections of highway and a brief description of some of the factors that affect the construction costs in each section.

Wrigley to Tulita

From the existing Hodgson Creek bridge at Wrigley, the alignment closely follows the Mackenzie River all the way to Tulita for a length of 235 kilometres.

A total of about 13 bridges (in addition to the three bridges already installed under the Winter Road Improvement Program) will be required on this section of highway linking Wrigley to Tulita. The longest bridge would be across the Blackwater River with a required length of approximately 200 metres. This would be similar to the existing bridge across the Willowlake River south of Wrigley. Up to 20 large diameter (>1.5 metres) culverts may also be required at minor stream crossings along this section of highway.

Because of the large number of creek and river crossings, a number of barge landing sites may have to be utilized for summer access to construction zones both for embankment construction and bridge construction.

Borrow sources for this section of highway vary from clay to granular material with some of it coming from right of way cuts (roadway excavation). Minor amounts of shale and sandstone could also be utilized between the Saline River and Big Smith Creek.

Winter construction of the embankment will be required between Big Smith Creek and Tulita, a distance of approximately 60 kilometres, due to the high moisture content of the available borrow material. This section will also require capping with higher quality granular borrow after embankment settlement occurs.

The estimated cost of construction for this 235 kilometre section is as follows:

Construction Activity	60 km/hr	80 km/hr
• Embankment Construction	$76,375,000	$94,000,000
• Bridge and Culverts	$27,000,000	$27,000,000
• Engineering	$10,335,000	$10,890,000
TOTAL:	**$113,710,000**	**$131,890,000**
Average Cost per Kilometre:	**$484,000**	**$561,000**

Tulita to Norman Wells

This is the shortest of the inter-community links with a distance of only 74 kilometres between Tulita and Norman Wells. The alignment is fairly direct between the communities and is approximately 10 kilometres away from the Mackenzie River at the farthest point.

On this section, the embankment would be constructed from a combination of limestone, shale and clay borrow. In order to access the Tulita end of the section during the summer, a three kilometre access road would have to be constructed from a barge landing site

about 1.5 kilometres north of the mouth of Great Bear River. The north end could be accessed from the existing road to the limestone quarry near Norman Wells.

Four or five bridges and an equal number of large diameter culverts are required at creek crossings between Tulita and Norman Wells. One of the bridges (Vermillion Creek) was completed in early 1999 and a second bridge will be completed at Canyon Creek in early 2000 as part of the on going Winter Road Improvement Program. Not included in the above is the major crossing required at the Great Bear River near Tulita.

A bridge across the Great Bear River would need to be approximately 400m long and it is doubtful if a single lane bridge would be suitable for such a length in such close proximity to the community. At the very least, it is expected that a separate pedestrian walkway with adequate guardrails would be required. Further engineering studies and community consultation will be required to determine the appropriate bridge design for this location.

The estimated cost of construction for this section is as follows:

Construction Activity	60 km/hr	80 km/hr
• Embankment Construction	$22,200,000	$27,750,000
• Bridge and Culverts	$6,000,000	$6,000,000
• Great Bear River Bridge	$12,000,000	$12,000,000
• Engineering	$4,020,000	$4,120,000
TOTAL:	**$44,220,000**	**$44,870,000**
Average Cost per Kilometre:	**$598,000**	**$674,000**

An alternative option, which must be assessed in more detail, is that of establishing ferry crossing facilities for the Great Bear River. Ferry crossing facilities at the Great Bear River would reduce the capital cost by approximately $7,000,000, however, the trade off would be seasonal road closures in the spring and fall and an approximate additional $500,000 in annual operating costs.

Norman Wells to Fort Good Hope

The alignment distance between Norman Wells and Fort Good Hope is 150 kilometres. The route follows along the Mackenzie River from Norman Wells until the river veers to the west at about the halfway point. From that point, the alignment stays at approximately 25 kilometres east of the Mackenzie River until they converge again near Fort Good Hope.

Available borrow material for this section consists of sand, gravel and limestone with some clay north of Norman Wells and gravel, shale, clay and limestone south from Fort Good Hope. The alignment can be accessed from the existing roads at Norman Wells, but at

Fort Good Hope, construction would have to start with building the 3 kilometre access road from the community to the highway alignment.

Nine or ten bridges are required between Norman Wells and Fort Good Hope in addition to the existing bridge at Bosworth Creek, just north of Norman Wells. The largest one would be approximately 100 metres long over the Donnelly River which is 55 kilometres south of Fort Good Hope.

The estimated cost of construction for the total of 153 kilometres of road required for this section is as follows:

Construction Activity	60 km/hr	80 km/hr
• Embankment Construction	$49,725,000	$61,200,000
• Bridge and Culverts	$8,000,000	$8,000,000
• Engineering	$5,775,000	$6,230,000
TOTAL:	**$63,500,000**	**$75,430,000**
Average Cost per Kilometre:	**$415,000**	**$493,000**

Fort Good Hope to the Dempster Highway

From Fort Good Hope, it is 345 kilometres to the proposed junction with the Dempster Highway 65 kilometres south of Inuvik. The alignment parallels the Mackenzie River for about two thirds of the way and then continues on to the Dempster Highway as the river turns and flows in a westerly direction towards Tsiigehtchic.

The north half of this section would be constructed almost entirely of shale borrow and the south half would be constructed from a combination of granular, shale and clay borrow materials. Access for construction would be from the Dempster Highway, Fort Good Hope and a potential central barge landing site on the Mackenzie River which would require construction of a 1.0 - 1.5 kilometre access road to the highway alignment.

Only five bridges and a few large diameter culverts are required over the 345 kilometre distance between Fort Good Hope and the Dempster Highway. The Hare Indian River near Fort Good Hope is the largest water crossing and will require a bridge in the order of 150 - 200 metres long.

The estimated cost of construction for this section of highway is as follows:

Construction Activity	60 km/hr	80 km/hr
• Embankment Construction	$138,000,000	$160,000,000
• Bridge and Culverts	$8,500,000	$8,500,000
• Engineering	$14,650,000	$15,165,000
TOTAL:	**$161,150,000**	**$15,165,000**
Average Cost per Kilometre:	**$467,000**	**$532,000**

Deline Access to the Mackenzie Highway

An access road from Deline to the Mackenzie Highway would be 125 kilometres long, if it were located entirely on the north side of the Great Bear River, or, only 105 kilometres long if it was located on the south side of the Great Bear River. Locating the road on the north side would avoid the need to cross the Great Bear River near Deline, where it flows out of Great Bear Lake. However, the shorter distance and lower per kilometre construction costs associated with the south side route appear to more than offset the additional cost of constructing a bridge across the river near Deline.

Cost estimates are provided below for both routes:

North Side (125 kilometres)

Construction Activity	60 km/hr	80 km/hr
• Embankment Construction	$40,625,000	$50,000,000
• Bridge and Culverts	$3,000,000	$3,000,000
• Engineering	$4,365,000	$4,770,000
TOTAL:	**$47,990,000**	**$57,770,000**
Average Cost per Kilometre:	**$384,000**	**$462,000**

South Side (105 kilometres)

Construction Activity	60 km/hr	80 km/hr
• Embankment Construction	$28,875,000	$36,750,000
• Bridge and Culverts	$3,000,000	$3,000,000
• Great Bear River Bridge (200m)	$6,000,000	$6,000,000
• Engineering	$3,790,000	$4,120,000
TOTAL:	**$41,665,000**	**$49,870,000**
Average Cost per Kilometre:	**$397,000**	**$475,000**

SUMMARY OF CONSTRUCTION COST ESTIMATES

The estimated construction costs for all of the sections are summarized below:

Road Section	60 km/hr	80 km/hr
• Wrigley to Tulita	$113,710,000	$131,890,000
• Tulita to Norman Wells	$44,220,000	$49,890,000
• Norman Wells to Fort Good Hope	$63,500,000	75.430,000
• Fort Good Hope to the Dempster	$161,150,000	$183,665,000
• Deline Access (South Side)	$41,665,000	$49,870,000
TOTAL:	**$424,245,000**	**$490,725,000**
Average Cost per Kilometre:	**$465,000**	**$538,000**

Depending on the design selection, the total cost for construction of the Mackenzie Highway extension and access road from Deline would be somewhere between 400 and 500 million dollars. It should be pointed out that the 60 kilometres per hour design could be changed to an 80 kilometres per hour design with an 8.4 metre roadtop for an additional cost of only about five percent. Such a road would still require widening if it were to be upgraded (changes to speed limits) and asphalt surfaced in the future.

OPERATION AND MAINTENANCE COSTS

The estimated annual maintenance costs for the Mackenzie Highway extension and Deline access road are somewhat dependant on the selected highway design. It will cost more to maintain a 10.0 metre wide roadtop than it will to maintain an 8.4 metre roadtop. Based on maintenance costs for various sections of the existing NWT Highway System, the basic annual highway maintenance costs (excluding bridges and large diameter culverts) for this study are estimated to be $9,000 per kilometre for the 8.4 metre roadtop and $9,500 per kilometre for the 10.0 metre roadtop. The annual maintenance costs for bridges and large diameter culverts are estimated to be an additional one percent of the initial capital cost of the structures.

The total annual estimated maintenance costs for the sections of highway are as follows:

Highway Section	60 km/hr	80 km/hr
• Wrigley to Tulita	$2,385,000	$2,502,000
• Tulita to Norman Wells	$846,000	$883,000
• Norman Wells to Fort Good Hope	$1,457,000	$1,534,000
• Fort Good Hope to the Dempster	$3,190,000	$3,363,000
• Deline Access (South side)	$1,035,000	$1,087,000
ANNUAL TOTAL:	**$8,913,000**	**$9,369,000**
Overall Average Annual Cost per Kilometre:	**$9,773**	**$10,273**

IMPLEMENTATION AND SCHEDULING

As mentioned previously, the cost estimates developed for this study were based on standard GNWT contracting policies and an eight (8) to ten (10) year construction period. This is considered to be the optimum time period for the efficient distribution of work and utilization of available resources.

However, in order to maximize local and northern economic benefits, a longer construction period may be more appropriate. In a 1992 report entitled *Implementation Plan for the Mackenzie Highway Extension*, the department recommended a 20 year construction period as the optimum time frame for maximizing economic benefits.

A discussion on a Community Based Construction Approach to improve the winter roads within the Sahtu Region is included as Appendix 'A'. Under this approach, the emphasis would be entirely on providing long term local economic/business opportunities and employment and training through a low level of annual funding distributed between the four Sahtu communities, Wrigley and communities in the Inuvik Region (Fort McPherson, Tsiigehtchic and Inuvik) and not on completing the road within a reasonable time frame.

The end objective would be to, firstly , extend the winter road operation period then complete a low standard all-weather road that would link the Sahtu communities to the Deh Cho Region and beyond.

Should the GNWT elect to proceed with construction of this highway extension project using the standard GNWT Public Tendering process, the first most probable area of construction activity would be on the Wrigley to Tulita section. The same approach, as mentioned in the Community Based Construction options, of extending the winter road operation period into the Sahtu Region would be employed. This will involve constructing bridges and culvert installations at major river and stream crossings. Once this river and stream work has been completed, the all-weather road embankment construction activities could then be distributed between the communities of Wrigley, Tulita and Norman Wells. The first priority would be to provide an all-weather road link from Wrigley to Norman Wells. A winter road from Fort Good Hope to the Dempster Highway could also be opened up during the same period of this construction activity. Once the all-weather road reaches Norman Wells, all-weather road embankment construction activity could be distributed between the communities of Norman Wells, Fort Good Hope and the Inuvik Region (Fort McPherson, Tsiigehtchic and Inuvik). The last area for construction would be the access road from the community of Deline, which will be dependant on the community's desire to have an all-weather road into their community.

Regardless of the selected construction time frame or construction approach, which will likely be more dependant on available funding than anything else, a minimum of one year of lead time would be required for pre-engineering and design and preparation of contract documents for the first construction location.

D.5 Executive Summary of the Benefit Cost and Economic Impact Analysis Mackenzie Valley Highway Extension

FINAL REPORT

BENEFIT-COST AND REGIONAL ECONOMIC IMPACT ANALYSIS: MACKENZIE HIGHWAY EXTENSION

Submitted to

Department of Transportation

by

Nichols Applied Management
Management and Economic Consultants
Edmonton Calgary

April, 1999

EXECUTIVE SUMMARY

Extending the Mackenzie Highway north from Wrigley is a long-term objective of the Department of Transportation. This report discusses the findings of an economic evaluation and regional economic impact analysis of the construction and operation of a 482 km extension to Fort Good Hope and a 832 km extension all the way to the Dempster Highway. A 105 km spur from just south of Tulita to Deline is incorporated in the study as an option, recognizing the current opposition to the road in that community.

The study uses cost estimates developed by the Department of Transportation, assuming a conventional public tender construction approach (60 km/hour design standard, ten-year construction period). It also addresses a Community Construction Approach to the project in which the highway will be built in small increments over an extended period.

Study Methodology

The study, undertaken by Nichols Applied Management, relies on the following sources for inputs:

- key respondent interviews and a review of Department of Transportation files to identify the benefits and costs of the proposed project; and
- an analysis by the Department of Transportation of the estimated project costs.

It uses two related but distinct analyses to assess the project. They are:

- a benefit-cost analysis, which determines the economic viability of the project from the perspective of the territorial economy; and
- a regional economic impact analysis, which focuses on the economic benefits to the region.

The study's discussion of the organizational implications of the Community Construction Approach builds upon the results of a workshop conducted by the study team with northern-based education and community development experts.

Project Benefits

Key respondents identified a range of project benefits. They are listed below:

- Prices in the Mackenzie Valley communities of Tulita, Norman Wells, Fort Good Hope, and Deline are expected to decrease as transportation and storage costs are reduced.

- Tourism expenditures are expected to increase when the Mackenzie Highway forms a loop with the Dempster Highway, stimulating visitor numbers and causing visitors to stay longer in the Northwest Territories.

- People, businesses, and public sector organizations including the health system in the Mackenzie Valley communities will have increased access to Fort Simpson and points beyond. This will likely mean an increase in operating efficiencies. Individuals are expected to travel more frequently between the communities, reducing their isolation.

- The Department of Transportation will not have to maintain the winter road between Wrigley, Fort Good Hope, and Deline.

- Oil and gas companies exploring the region will face reduced transportation costs and avoid "stand-by" costs for equipment now barged up and idled until freeze-up.

Some identified benefits were not further quantified because no ready market value estimates were available. These include the anticipated increase in the quality and variety of goods available in Mackenzie Valley communities and the increased access for hunters and trappers.

Project Costs

The Department of Transportation developed a preliminary construction cost estimate. Other costs are incurred as well because additional money will have to spent to realize some of the benefits. The costs are listed below:

- The construction cost of the road between Wrigley and Fort Good Hope is estimated at $220 million. The cost of extending it to the Dempster Highway and to Deline is estimated at $160 million and $40 million, respectively.
- Maintenance of the all-weather road is estimated at $10,000 per kilometre or between $2.2 million and $4.4 million per year, depending on the project configuration.
- The tourism industry will need to spend money to supply the products desired by visitors. This includes the cost of restaurant meals, tour operator supplies, wholesale groceries, and bulk fuel.
- Increased mobility implies costs, including additional ground transportation costs and increased accidents.

Some costs were not quantified because no market values are available. These include the cost of increased hunting and trapping pressure and possible impacts of the road on wildlife migration patterns.

Benefit-Cost Analysis

The benefit-cost analysis compares the discounted benefits and costs of the Mackenzie Highway Extension. The discounted benefits need to be greater than the discounted costs for the project to be economically viable. A benefit-cost ratio of one or larger and a positive value of the net present value of the difference between the costs and benefits indicates economic viability.

The benefit-cost ratio of the project, assuming a 7.5% discount rate, is estimated at 0.16 for all scenarios. The estimates of the present value of the benefits (net of the present value of the costs) range from minus $173 million to minus $285 million.

	Wrigley to Ft Good Hope		Wrigley to Dempster Highway	
	With Deline	Without Deline	With Deline	Without Deline
	7.5% Discount Rate			
Net Present Value ($'000)	($197,000)	($173,000)	($285,000)	($267,000)
Benefit-Cost Ratio	0.16	0.16	0.16	0.16

This result is in line with other assessments of the economics of the Mackenzie Highway and similar roads. A 1983 study of the completion of the Mackenzie Highway to Wrigley places the benefit-cost ratio at 0.2, using a 10% discount rate. A 1990 study of The Mackenzie Highway Extension to the Dempster Highway, conducted in support of the 1990 Transportation Strategy Update, calculates a benefit-cost ratio of 0.45, using a 3% discount rate. Finally, a recent study of the Inuvik to Tuktoyaktuk road estimates the benefit cost ratio of that road project at 0.26, using a 7.5% discount rate.

The results of the benefit-cost analysis indicate that the Mackenzie Highway Extension is not viable from a strictly economic perspective. This result is confirmed by an analysis of the sensitivity of the results to changes in the underlying assumptions. Increasing the benefits and reducing the cost by an arbitrary 25% and including potential cost savings associated with the production of as yet unfound oil reserves raise the benefit-cost ratio to 0.41.

However, many public investments in infrastructure and programs are made on the basis of social rather than economic considerations. The regional economic impact analysis looks at the project from a regional development perspective, focusing on redistributing economic activity and benefits among regions.

Regional Economic Impact Analysis

The project will generate employment and income benefits to the region in the following ways:

- local hiring of construction workers and project spending on wages, materials, and equipment during construction;
- increased local hiring of maintenance workers and spending on wages, materials, and equipment for the maintenance of the all-weather road as compared to annual spending on the ice road; and
- increased tourism spending accruing to local operators and their suppliers.

These regional construction impacts are related to project scope and are estimated at:

- between $41 to $85 million of business and labour income; and
- between 1,250 and 2,360 person-years of on-site labour.

These economic impacts accrue to the region over the 10-year construction period. The project could also provide additional training positions for persons interested in equipment operations and the heavy duty mechanics trade.

The ongoing road maintenance will also provide economic benefits. These depend on the project scope and are estimated at:

- between $1.4 million and $2.8 million per year in additional business and labour income; and
- between 26 and 55 additional person-years of employment per year.

The anticipated increase in tourism will increase the employment opportunities in the region.

Seen from a regional perspective, the project strengthens the local economy by providing additional business and labour income and by creating additional jobs. This is significant for the Mackenzie Valley communities, where unemployment levels are high.

Assuming that the project is financed from outside the study area, the employment and income benefits will be without cost to the region. This means that the project will lead to a redistribution of income within the Northwest Territories or, if financed by the federal government, within Canada. The redistributive effect of the project is reduced if it is financed in part by regionally-based organizations. In that case, the project would likely pre-empt other investment in the region.

Community Construction Approach

It is possible to construct the road not as a short-term construction project, but as a long-term regional development initiative. The Community Construction Approach, defined as $1 million per year construction projects in each of the five Mackenzie Valley communities, shifts the focus from road building to long-term economic development. This approach has the following annual economic impacts:

- additional business and labour income estimated at $1.8 million; and
- additional employment estimated at nine on-site person-years.

The Community Construction Approach would provide:

- a modest stimulus to the regional economy; and
- some training opportunities for local people, especially if a way can be found to deliver the appropriate trades training in the region.

The Community Construction Approach would not place any undue stress on the labour market of the region and would provide some training positions for equipment operators and heavy-duty mechanics.

Organizational Considerations

Constructing the road using a Community Construction Approach implies that the Department of Transportation (DOT) would need to extend its range of activities to include community consultation, education, and economic development, which are the focal points of this approach.

An alternative is for DOT to build a partnership with claims organizations and other government departments, and maybe other organizations, such as cultural institutes, industry, and literacy groups. This has several advantages, such as:

- increased ownership of the project by the affected communities;
- access to existing channels for community consultations; and
- increased likelihood for maximization of education and economic development benefits.

The recent experience with the Nunavut Unified Human Resources Development Strategy (NUHRDS) suggests that the partnership be formalized by the creation of an independent project office or secretariat, which brings together representatives of the participating claims organizations and government departments.

Conclusion

The construction of the Mackenzie Highway Extension road can be a tool for regional economic development. It provides income and employment opportunities during construction and operation and will contribute to the further development of the tourism industry in the region.

The project is not attractive from a strict economic perspective. Its strengths are in the redistribution of wealth rather than in creating it.

D.6 Executive Summary of the Financing Study Mackenzie Valley Highway Extension

FINAL REPORT

HIGHWAY FINANCING STUDY

Submitted to

Government of the Northwest Territories
Department of Transportation

by

Nichols Applied Management
Management and Economic Consultants
Edmonton Calgary

August 1999

EXECUTIVE SUMMARY

This study of highway financing in the Northwest Territories (NWT) is part of the 1998/1999 Highway Strategy Initiative of the Department of Transportation of the Government of the Northwest Territories (GNWT). The results of this study and others undertaken as part of the initiative will be used to develop project concepts, information data bases, and to further the plan for advancing new road projects.

The study approaches financing of the Inuvik to Tuktoyaktuk Road and the Mackenzie Valley Highway Extension in two ways. First, it provides an overview of financing and revenue-generating options used in Canada and the U.S. and discusses their applicability to the situation in the NWT. Second, it gives an overview of currently available programs that could be used to reduce the total highway construction costs and reports on the discussion with regional claims organizations regarding their potential involvement in the projects.

Traditional Highway Financing

Most highway construction in Canada is done using public tenders, financed out of provincial government budgets. This approach to highway construction would imply an annual construction budget of between $10 million and $80 million for five to 10 years to build the $100 million Inuvik to Tuktoyaktuk Road or the $220 million to $400 million Mackenzie Valley Highway Extension. The cost of the latter project depends on its final configuration. Such commitments are well beyond the capacity to the Department of Transportation, which has a total annual budget of $66 million, $17 million of which is allocated to the highway construction, mostly rehabilitation of existing roadways.

There is limited capability in the NWT to finance the projects by issuing debt. The size of the NWT economy limits the ability of the GNWT to repay debt. In addition, the GNWT does not have a history of debt issuance and repayment, reducing the likelihood of success of any forays into the capital or debt markets.

Financing Alternatives

Other jurisdictions in Canada and the US have tried new ways of infrastructure financing and have explored new or enhanced revenues associated with highway projects. They are summarized in the following table, which also discusses their applicability to the NWT.

Summary of Financing and Revenue Generating Alternatives	
Source of Capital/Revenue	**Applicability to NWT**
Private Equity/Debt	Limited. Projects have a very limited ability to provide the desired rate of return on the private investment.
Grant Anticipation Revenue Vehicle	Very limited. DOT funds for highway construction are committed in the near and intermediate terms.
Gaming Revenue	Very limited. Only $100,000 in licensing fee income flows into general revenue.
User Tolls	Very limited. Low utilization of roads.
Shadow Tolls	Limited. GNWT budget insufficient to provide payments to compensate private sector developers.
Registration Fees	Very limited. Low number of vehicles in the NWT. Used mostly in urban or densely populated areas.
Parking Charges	Very limited. With a few exceptions, no parking charges are levied in the NWT. Used mostly in large urban areas.
Area Licensing/Permit	Very limited. Designed to reduce congestion, which is not an issue in the NWT.
Fuel Tax	Limited. A 10% increase in all fuel taxes would raise not more than $0.7 million per year.
Sales Tax	Limited. Potential to generate revenue is offset by the low level of public acceptance.
Motor Vehicle Property Tax	Very Limited. Low revenue potential due to the limited number of cars.
Special Assessment District/ Tax Increment Funding/ Offsite Levy	Very Limited. Low traffic volumes will limit the likely development along the highways.
Development Agreement	Limited. The oil and gas industry, which is likely the most active industry in the area in the near and medium term, is not dependent on a road.

The information in the table supports the conclusion that the projects will not be built using a public tender approach without considerable infusion of public money. In this regard, there are a number of reasons for federal involvement, including the federal mandate for economic and resource development and the federal responsibility for new highway construction in the NWT.

Community Construction Approach

The Community Construction Approach phases the construction over 30 years or more, reducing the annual construction costs to $2 million to $4 million. It is a way in which some new Department of Transportation money can jumpstart the projects. The projects can then be used to present training and business development opportunities for local area people and businesses.

The Community Construction Approach provides possibilities for using existing training and business development programs to augment the annual Department of Transportation contribution. Programs that may be used as part of the Community Construction Approach include:

Summary of Programs	
Program	**Selected Services**
Business Credit Corporation (RWED)	• Loans to business enterprises. • Loan guarantees and business bonds.
Business Development Fund - (RWED)	• One-time assistance with business planning/development costs. • Assistance with the acquisition or development of capital goods. • Venture capital assistance. • Assistance to upgrade business skills.
Training-on-the-Job (ECE)	• 80% of trainee's gross salary to a maximum. • Tuition reimbursements to a maximum.
Working Together (ECE)	• Up to $5/hr (or 90% of minimum wage) for a student or youth worker. Maximum contract: one year.
Building and Learning Strategy (ECE)	• Training costs for trainees. • Wage subsidy to the contractor.
Skills for Work (ECE)	• Training costs for trainees. • Wage subsidy to the contractor.
Apprenticeship Training Program (ECE)	• Wage subsidy for apprentices over a three-year period. The maximum subsidy is reduced as the apprentice gains experience and becomes more productive.
Employment Insurance Training (ECE/HRDC)	• Training allowance of $675/week. • Additional support is available for tuition, transportation to the place of instruction and childcare.
Indian Management Assistance Program (DIAND)	• Wage subsidy for a university student who works for an aboriginal groups in a managerial role during the summer months.
Business Opportunity Fund (DIAND)	• One-time funding to the aboriginal group desiring to undertake an appropriate business venture.
Aboriginal Human Resources Strategy (HRDC)	• Employment programs that reflect and serve Aboriginal needs at the local labour market level. • Local board accepts and evaluates proposals for training and labour market development programs.

There may be options for future private sector involvement in training and labour force development through benefit agreements. This option is very dependent on further resource development in the region.

There are several limitations to this approach, including:

- training programs tend to subsidize only part of the wage costs incurred and wage costs account for only about one-third of construction costs;
- training budgets are constrained and often include a geographic distribution of program expenditures;
- the eligibility of the project work forces for training assistance will reduce over time as their training levels increase; and
- only one program that assists with the purchase of equipment was identified and none that help with equipment operating costs.

These observations notwithstanding, the Community Construction Approach offers opportunities for regional economic development.

Claimant Groups

The affected claimant groups will need to be involved in the projects. The proposed highways cross Inuvialuit, Gwich'in and Sahtu lands and the claims organizations represent the people who will most benefit from the highway projects. They are also the major source of investment capital in the region.

Discussions conducted as part of this study indicate an interest by the claims organizations to be part of the projects. The exact nature of their involvement will need further discussions, but possibilities include resource royalty waivers and equity participation.

Conclusion

Building the Inuvik to Tuktoyaktuk Road and the Mackenzie Valley Highway Extension using a traditional Public Tender Approach will require substantial new public money. This suggests that the GNWT

should continue to work with its provincial counterparts to ensure that the federal government meets it's mandate for economic and resource development and responsibility for new highway construction in the NWT.

Short of that, The Community Construction Approach is an alternative in which the Department of Transportation can jumpstart the projects, using some additional highway construction funds. The projects can then provide a vehicle for local access to existing government training and business development programs, creating regional economic development with a highway construction focus.

The department will need to continue to work with the claimant groups to explore their role in more detail. Showing a government commitment to a sustained economic development process using highway construction as a focus may be an inducement for claims groups to enter into the discussion. Any equity participation by these groups may augment and enhance the government-sponsored construction activity. It could also replace it, with the public funds then allocated to shadow tolls to compensate investors.

The Community Construction is not incompatible with the Public Tender approaches. With a modest budget reallocation, the Community Construction Approach can be initiated in the near term. It can be scaled up if claims groups become actively involved. Then, if changes in the fiscal situation of Canada and the NWT will allow new public investment in infrastructure, the Community Construction Approach can be superseded by the Public Tender Approach.

E. Highway 3 Accelerate Reconstruction

E.1 Introduction

Reconstruction of Highway 3 from Rae to Yellowknife is in the Department of Transportation's current Capital Plan. Reconstruction commenced in the summer of 1999 with projects at both the Rae and Yellowknife ends.

By the end of the summer of 1999 it is expected that there will be 77 kilometres of gravel surface left to reconstruct and pave.

The Department conducted a study on the pros and cons of accelerating reconstruction. The results were presented to the Slave Geologic Province Stakeholder Advisory Committee meeting on March 16, 1999. The Department has also discussed the study results with various interest groups as it has been invited to do so.

As noted in the next section, the Department has concluded that acceleration using GNWT funding is not the preferred approach. However, it should be noted that Highway 3 would be eligible for funding under a potential federal National Highway Program. This will allow the Department to accelerate reconstruction, without incurring additional financing costs.

E.2 Report on the Pros and Cons of Accelerating Highway 3 Reconstruction

REPORT ON

PROS AND CONS OF ACCELERATING HIGHWAY 3 RECONSTRUCTION

March, 1999

Prepared by
Department of Transportation
Government of the Northwest Territories

PROS AND CONS OF HIGHWAY 3 ACCELERATED RECONSTRUCTION
TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Purpose of Paper
1.2 Impetus for Acceleration
1.3 Background

2.0 ISSUES TO CONSIDER

2.1 Timing/Construction Costs
2.2 Hwy Users
  a) Safety
  b) Vehicle Operating Costs
  c) Travel Time
2.3 Operations and Maintenance Costs
2.4 Capacity
2.5 Tourism
2.6 Environmental Implications
2.7 Impact on DOT staff
2.8 Financing
  a) Borrowing Costs
  b) Other Issues
2.9 Employment and Training Opportunities
2.10 Northern Contractors Capabilities
2.11 Government/Department Highway System Management Factors
2.12 National Highway System

3.0 SUMMARY & CONCLUSIONS

3.1 Summary

PROS AND CONS OF ACCELERATING HIGHWAY 3 RECONSTRUCTION

1.0 INTRODUCTION

1.1 Purpose of Paper

This paper highlights the issues the Department of Transportation has considered in the evaluation of whether the reconstruction of Highway 3 between Rae-Edzo and Yellowknife should be accelerated or not.

1.2 Impetus for Acceleration

The impetus for accelerating the reconstruction of the remaining 75 kilometres of Highway 3 between Yellowknife and Rae-Edzo is largely found in the concerns about traffic safety, travel comfort and vehicle operating costs being voiced by people and/or businesses in Yellowknife and Rae-Edzo.

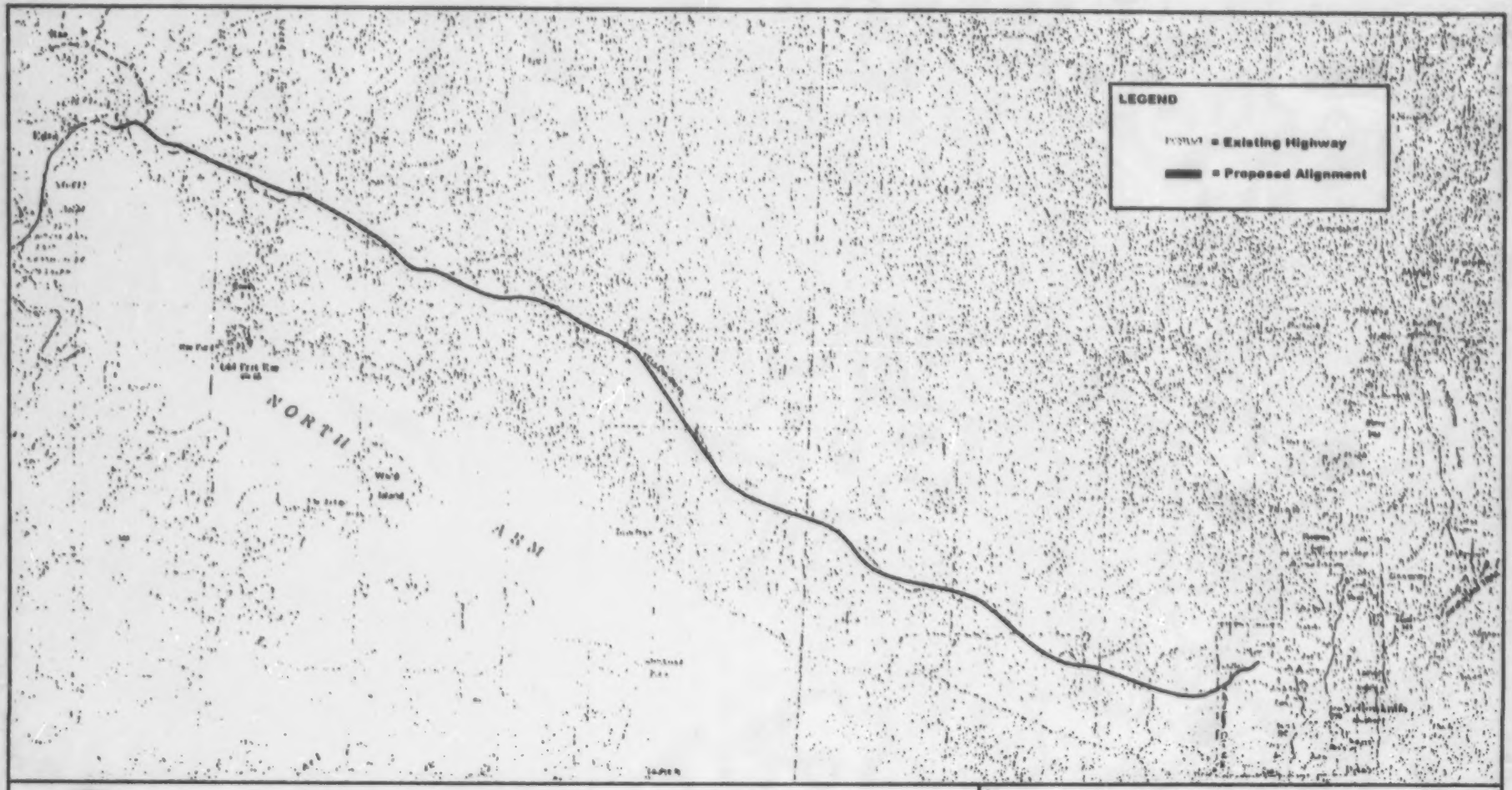
Local municipal politicians and MLA's who represent Yellowknife and Rae-Edzo have noted these concerns and have raised the issue of accelerating reconstruction of Highway 3 in their respective political venues.

One other reason that has been put forward in favour of acceleration is that potential mineral development in the Slave Geologic Province will increase the traffic using this road resulting in further compromises on traffic safety, flow and road maintenance. In 1997 the Average Annual Daily Traffic on this road was 390 vehicles. Heavy trucks comprised 25% to 30 % of this traffic.

1.3 Background

Reconstruction and paving of Highway 1 & 3 from the Alberta border to Yellowknife, which is part of the National Highway System, has been one of the Department of Transportation's priorities since the Department was established in 1989. From fiscal 1990/91 through to 1998/99 the Department has committed $131 million to upgrade 438 km or 83% of the 528 km length of this route. The only section remaining to be reconstructed and paved is the 90 km section from Rae-Edzo to Yellowknife.

The two current reconstruction contracts (one at the Rae end, the other at the Yellowknife end) to be completed by the Fall of 1999 will leave 75 km of this road to be reconstructed and paved.



Northwest Territories Transportation

YELLOWKNIFE HIGHWAY (No.3)
Km 243 - Km 333 RECONSTRUCTION
PROPOSED ALIGNMENT

Scale: 1:250,000

Date: July 1997

2.0 ISSUES TO CONSIDER

2.1 Timing/Construction Costs

Reconstruction and paving of the remaining 75 km section of Highway 3 is estimated to cost $750,000 per km for a total of $56 million. At an average capital allocation of $6.0 million per year as programmed in the Department's Capital Plan, this road will take another 10 or more years to complete (i.e. by 2009/10).

Acceleration, which would require borrowing of project monies could complete reconstruction in 3 years, with the first year of construction commencing in fiscal year 2000/01 and ending in 2002/03. Because of the economies of scale involved, acceleration is estimated to save 10% in construction costs or $75,000 per km. Acceleration exclusive of financing costs would therefore cost $50 million.

Acceleration will complete Highway 3 reconstruction 7 years sooner versus normal Department allocation and tendering processes.

2.2 Highway Users

a) Safety

Motorists using Highway 3 cite its current width, number of curves, driving surface and sight distances among other roadway features as being substandard elements that are contributing to an unsafe driving environment.

To evaluate these concerns, collision rates for three sections of Highways 1 & 3 were compared. Table 1 and 2 in the Appendix compare the number of collisions, fatalities and collision rates (with alcohol included and alcohol excluded) for a five year period, 1993 to 1997. The Department acknowledges that use and interpretation of collision statistics for low volume roadways are subject to some discretion.

Table 1 shows that Highway 1 from the Alberta border to Enterprise (84km) has an average of 5.20 collisions per year or a collision rate of 0.81 collisions per million vehicle-kilometres of travel (MVK). This compares to an average of 18.6 collisions per year or 1.62 collisions per MVK for Highway 3 between Rae-Edzo and Yellowknife (90 km) and an average of 17.0 collisions per year or a 1.58 collision rate for Highway 3 south of Rae-Edzo (212 km). Reconstruction of the highway south of Rae was completed in 1997 and therefore the full benefit of improved geometrics is not reflected in the collision history for the years prior to and including 1997.

Table 2 considers these same roadway sections but excludes alcohol related collisions.

Acceleration would improve roadway geometrics and therefore traffic safety for highway users sooner.

b) Vehicle Operating Costs

Vehicles travelling on a paved surface incur less tire and driveline component wear and tear due to the smoother surface. Operating costs for vehicles using a paved roadway are estimated to be some 15 percent lower than those for a gravel roadway (i.e. 36 cents per kilometre versus 42 cents for a passenger car). A passenger car driving this 75 kilometre section on asphalt versus gravel could be expected to save $4.50 on a one-way trip. Overall it is estimated that vehicle operating costs for both cars and trucks would be lowered by some $1 million per year once the highway is reconstructed.

Acceleration would lower vehicle operating costs sooner to highway users.

c) Travel Time

Travel time for vehicle operators on Highway 3 is a function of the road surface, geometry, driver experience, familiarity with the road and the posted speed limit. Travel time savings for the remaining 75 kilometres, depending on vehicle type would be in the order of 6 to 10 minutes.

Acceleration would provide marginal travel time benefits sooner to highway users.

2.3 Operations and Maintenance Costs

The current annual maintenance costs for the existing highway including the periodic application of surfacing material amounts to about $11,700 per km. Following reconstruction and paving (chipseal) these costs should drop by 20% or approximately annual savings of $2,340 per km or over $165,000 for the remaining 75 kilometres. O&M savings will be realized sooner with acceleration. These savings could be directed to other system maintenance concerns.

Acceleration will realize Operations & Maintenance cost savings sooner.

2.4 Capacity

The capacity of a roadway is mainly determined by its geometry, and to a lesser extent traffic control and vehicle mix. The current theoretical capacity of Highway 3 between Rae-Edzo and Yellowknife based on Transportation Association of Canada standards is 320 vehicles per hour. Current traffic volumes are in the area of 30 vehicles per hour.

Volume to capacity ratios of .75 or greater are typically used to justify geometric improvements. The existing volume to capacity ratio of .10 suggests that capacity is not a concern at this time or even in the immediate future if the development of the Diavik Diamond Mine is allowed to proceed. Additional mineral development in the Slave Geological Province following after the development of the Diavik mine is not expected for at least 10 years or at a minimum after reconstruction of Highway 3 is completed by normal or accelerated construction means.

There is no need for acceleration based on capacity concerns.

2.5 Tourism

Almost half of the visitors to Yellowknife travel by road. Visitor exit surveys conducted by the Parks and Tourism Division of the Department of Resources, Wildlife & Economic Development suggest there is no evidence that ground trips to Yellowknife are being delayed, postponed or redirected to other destinations due to highway conditions. This finding is likely linked to the fact that 83% or 438 kilometres of the road from the Alberta border is now paved,

There is no need for acceleration based on current tourism data.

2.6 Environmental Implications

The acceleration of Highway 3 reconstruction proposes no new construction technology. The potential effects and mitigation measures required for this project are based on terms and conditions placed on land use permits previously obtained by the Department for similar highway projects, as well as experience obtained by the Department from similar developments in other jurisdictions

Based on preliminary environmental scoping studies only, acceleration would not exacerbate existing environmental concerns or generate any significant non-mitigable adverse environmental impacts.

2.7 Impact on DOT Staff

Accelerating reconstruction will effectively reduce the Department's capital budget in the years following reconstruction while borrowed monies are being paid off. This reduction in the capital budget will be reflected in less project design and management activity.

Reduced staffing levels could result in loss of experienced/skilled program staff to other jurisdictions. Loss of this staff could impact on the Department's ability to deliver programs effectively once budget dollars are restored.

The Department could realize some O&M savings related to staff salaries and benefits that could be utilized in other departmental program areas.

Acceleration will have a negative effect on DOT staffing .

2.8 Financing

a) Borrowing Costs

To accelerate the Department of Transportation would have to tender two or more multi-year contracts for the reconstruction of sections of the highway with a fixed completion date within 3 years. The value of these contracts at approximately $16.7 million would exceed the current annual capital allocation of $6.0 million and would therefore have to be financed via government or private sector borrowing arrangements. Financing by borrowing would thus incur additional interest charges beyond the traditional method used for construction. Tables 3 and 4 in the Appendix detail plausible government and private borrowing scenarios and costs that the Department might face if it were to accelerate reconstruction over 3 years.

An assessment of borrowing costs for an acceleration program over 5 years was also looked at. Respective GNWT and private sector borrowing costs are shown in Tables 5 and 6 in the Appendix. A 5-year acceleration program incurs approximately $4.5 million less in borrowing costs versus a 3 year program. It is not known whether the economies of scale expected for a 3-year program would also be realized for a 5-year program.

Acceleration over 3 years would incur financing costs ranging from $5.1 million (GNWT borrowing at 6.15%) to $33.4 million (private sector borrowing at 12.5%).

b) Other Issues

It is acknowledged that acceleration could provide benefits sooner to highway users. This logic could also be applied to most other Department of Transportation or GNWY capital projects. Historically, the Legislative Assembly has not considered the timing of benefits provided by a capital project as a criterion for borrowing monies.

Public-Private Partnerships (P3) is another means the government has used to accelerate capital projects. However, highway projects do not meet the P3 criteria.

Acceleration would require borrowing of capital for which there is no precedent in the GNWT.

2.9 Employment and Training Opportunities

A prime objective of the Highway Strategy is to maximize the employment and training opportunities for Northerners in road construction. For example, the contract to reconstruct 13 km of Highway 3 from Frank Channel to Stagg River (single construction season) will generate 34 positions for pre-certificate training and 16 positions for certificate training. Based on an analysis done by the Department of Transportation, compressing the construction timeframe from 10 to 3 years could potentially reduce the number of training opportunities by some 250 training positions. A 5-year construction time frame would see a loss of some 130 training opportunities.

With regard to employment, acceleration could create a boom/bust situation for residents and workers from Rae and Yellowknife. There is also a possibility that there may not be enough local/northern residents to staff the positions needed for construction. Some jobs will be staffed with people from outside the Territories. It is likely that it will be impossible to maintain a 90% Northern workforce. Equipment may also have to be brought in from the south.

Acceleration will reduce the number of training opportunities for northerners and narrow the timeframe and magnitude for northern employment benefits.

2.10 Northern Contractor Capabilities

The current construction industry in the NWT has only one construction firm which on it's own has undertaken road construction contracts of five million dollars or more. All other construction firms align themselves with outside firms when bidding contracts in excess of five million dollars.

Advancing the work and tendering twenty five million dollar contracts would attract large outside contractors who may encourage medium sized local construction companies to align with them to bid the work.

The shortening of the construction program would have a negative affect on local construction companies as opportunities to bid work would be reduced from approximately 10 yearly contracts to only 2 or 3 larger contracts.

Acceleration would reduce the number of opportunities for local northern construction companies to bid on Highway 3 work

2.11 Government/Department Highway System Management Factors

The impending division of the Territories and political uncertainty has increased the effort of various communities, groups and regions in the western Northwest Territories to secure GNWT highway infrastructure dollars. Since 1990 the

Department of Transportation has spent over $183 million on the Highways Program. Of this amount over $131 million or 69% of the Highways Program capital budget has been directed to the upgrading of Highways 1 and 3 route from the Alberta border to Yellowknife.

Acceleration and the related long term commitment of a portion of the Highway Program capital budget to cover financing costs will restrict the Legislative Assembly's and Department's ability to react to other highway needs within the western Northwest Territories.

Acceleration reduces the Government's and Department's ability to react to other highway needs within the western Northwest Territories.

2.12 National Highway System

The route from the Alberta Border to Hay River and Yellowknife, including part of Highway 1 and all of Highways 2 and 3 is part of the designated National Highway System. The provinces and territories have been actively lobbying the federal Minister of Transportation for federal funding to construct and complete this system to an agreed standard. Some federal funding for National Highway system projects may be forthcoming in the next two fiscal years under a potential National Highways Program. Sections completed to standard prior to the establishment of a National Highways Program would not qualify for retroactive federal funding assistance.

Acceleration could eliminate the eligibility of the completed sections of Highway 3 under a potential Highway Program.

3.0 SUMMARY & CONCLUSIONS

Any decision to accelerate Highway 3 reconstruction must be made against a range of issues that offer a mix of positive, negative and neutral benefits.

Positive impacts associated with acceleration include:

- Improvements to roadway safety
- Lower vehicle operating costs and travel time
- Lower Operations and Maintenance costs
- Benefits come 6 years sooner

Neutral Impacts associated with acceleration include:

- Capacity
- Tourism
- Environmental Implications

Negative impacts associated with acceleration include:

- Significant financial costs
- Reduced training and employment opportunities
- Bid opportunities for Northern Contractors are reduced
- DOT staff
- Government/Department ability to react to other needs is reduced

The Department of Transportation in making a decision has relied on four issues with strong empirical basis namely; financing costs, reduced employment and training opportunities, reduced bidding opportunities for Northern Contractors and reduction in Government/Department flexibility to react to other capital needs.

The Department has concluded on balance that the cons outweigh the pros and that it will not recommend acceleration of Highway 3 between Rae-Edzo and Yellowknife.

Appendix A

Table 1

Collision Rate Comparision, 1993-97

Year	Highway Section											
	Highway #1 NWT Border to Enterprise (Km 0 to 84)				Highway #3 Fort Providence to Rae (Km 31 to 243)				Highway #3 Rae to Yellowknife (Km 243.4 to 333.5)			
	Rate*	# Collisions	# Fatal Collisions	# Persons Killed	Rate*	# Collisions	# Fatal Collisions	# Persons Killed	Rate*	# Collisions	# Fatal Collisions	# Persons Killed
1993	1.00	6	0	0	2.53	23	0	0	2.16	22	1	1
1994	0.31	2	0	0	2.50	24	0	0	1.84	20	0	0
1995	1.34	9	0	0	1.09	14	0	0	0.95	11	1	1
1996	0.48	3	0	0	1.05	13	0	0	1.28	16	2	2
1997	0.91	6	1	2	0.72	11	0	0	1.87	24	0	0
Average	0.81	5.20	0.20	0.40	1.58	17.00	0.00	0.00	1.62	18.60	0.80	0.80

* Collisions per million vehicle-kilometres

Table 2

Collision Rate Comparision, 1993-97**

Year	Highway Section					
	Highway #1 NWT Border to Enterprise (Km 0 to 84)		Highway #3 Fort Providence to Rae (Km 31 to 243)		Highway #3 Rae to Yellowknife (Km 243.4 to 333.5)	
	Rate*	# Collisions	Rate*	# Collisions	Rate*	# Collisions
1993	1.00	6	2.31	21	1.96	20
1994	0.31	2	2.40	23	1.75	19
1995	1.04	7	1.01	13	0.69	8
1996	0.48	3	0.89	11	0.96	12
1997	0.91	6	0.72	11	1.40	18
Average	0.75	4.80	1.47	15.80	1.35	15.40

* Collisions per million vehicle-kilometres

** Excludes alcohol-related collisions

Table 3

Highway 3 Reconstruction Rae to Yellowknife
Project Financing Requirements (Million $'s)

GNWT Borrow at 6.15%, Repayment at $6.0 million/year

Year	2000/01													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Funding Required	16.7	16.7	16.7											50.0
DOT Allocation to Project	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	1.1			61.1
Cummulative Debt at Start of Year	0.0	11.3	23.3	36.1	32.0	27.5	22.9	17.9	12.6	7.1	1.1	0.0	0.0	
Borrowings	10.7	10.7	10.7											32.0
Payments	0.0	0.0	0.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	1.1	0.0	0.0	43.1
Annual Interest Cost	0.7	1.4	2.1	1.9	1.6	1.3	1.0	0.7	0.4	0.1	0.0	0.0	0.0	11.1
Cummulative Debt at End of Year	11.3	23.3	36.1	32.0	27.5	22.9	17.9	12.6	7.1	1.1	0.0	0.0	0.0	
Interest Rate	6.15%													

Note: Total Cost - Traditional Method $56.0 million
Total Cost - Acceleration $61.1 million
Additional Funding Required $5.1 million

Table 4

Highway 3 Reconstruction Rae to Yellowknife
Project Financing Requirements (Million $'s)

Private Sector Borrow at 12.5%, Repayment at $6.0 million/year

Year	2000/01															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Funding Required	16.7	16.7	16.7													50.0
DOT Allocation to Project	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.4	89.4
Cummulative Debt at Start of Year	0.0	12.0	25.5	40.7	39.0	37.2	35.0	32.7	30.0	27.0	23.6	19.8	15.6	10.8	5.4	
Borrowings	10.7	10.7	10.7													32.0
Payments	0.0	0.0	0.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.4	71.4
Annual Interest Cost	1.3	2.8	4.5	4.3	4.1	3.9	3.6	3.3	3.0	2.6	2.2	1.7	1.2	0.6	0.0	39.4
Cummulative Debt at End of Year	12.0	25.5	40.7	39.0	37.2	35.0	32.7	30.0	27.0	23.6	19.8	15.6	10.8	5.4	0.0	
Interest Rate	12.5%															

Note:	Total Cost - Traditional Method	$56.0 million
	Total Cost - Acceleration	$89.4 million
	Additional Funding Required	$33.4 million

Table 5

Highway 3 Reconstruction Rae to Yellowknife
Project Financing Requirements (Million $'s)

GNWT Borrow at 6.15%, Repayment at $6.0 million/year

Year	2000/01													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Funding Required	10.0	10.0	10.0	10.0	10.0									50.0
DOT Allocation to Project	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	2.6	0			56.6
Cummulative Debt at Start of Year	0.0	4.2	8.8	13.5	18.6	24.0	19.1	13.9	8.4	2.6	0.0	0.0	0.0	
Borrowings	4.0	4.0	4.0	4.0	4.0									20.0
Payments	0.0	0.0	0.0	0.0	0.0	6.0	6.0	6.0	6.0	2.6	0.0	0.0	0.0	26.6
Annual Interest Cost	0.2	0.5	0.8	1.1	1.4	1.1	0.8	0.5	0.1	0.0	0.0	0.0	0.0	6.6
Cummulative Debt at End of Year	4.2	8.8	13.5	18.6	24.0	19.1	13.9	8.4	2.6	0.0	0.0	0.0	0.0	
Interest Rate	6.15%													

Note:	Total Cost - Traditional Method	$56.0 million
	Total Cost - Acceleration	$56.6 million
	Additional Funding Required	$0.6 million

Table 6

Highway 3 Reconstruction Rae to Yellowknife
Project Financing Requirements (Million $'s)

Private Sector Borrow at 12.5%, Repayment at $6.0 million/year

Year	2000/01													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Funding Required	10.0	10.0	10.0	10.0	10.0									50.0
DOT Allocation to Project	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	3.1	0.0	69.1
Cummulative Debt at Start of Year	0.0	4.5	9.6	15.3	21.7	28.9	25.7	22.2	18.2	13.8	8.7	3.1	0.0	
Borrowings	4.0	4.0	4.0	4.0	4.0									20.0
Payments	0.0	0.0	0.0	0.0	0.0	6.0	6.0	6.0	6.0	6.0	6.0	3.1	0.0	30.1
Annual Interest Cost	0.5	1.1	1.7	2.4	3.2	2.9	2.5	2.0	1.5	1.0	0.3	0.0	0.0	19.1
Cummulative Debt at End of Year	4.5	9.6	15.3	21.7	28.9	25.7	22.2	18.2	13.8	8.7	3.1	0.0	0.0	
Interest Rate	12.5%													

Note: Total Cost - Traditional Method $56.0 million
Total Cost - Acceleration $69.1 million
Additional Funding Required $13.1 million